

**Doctoral dissertation**



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**Natural capital and human well-being: what are the links?  
A study among rural inhabitants from Kodagu district  
(Karnataka state), India.**

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UNIVERSITAT AUTÒNOMA DE BARCELONA  
Institut de Ciència i Tecnologia Ambientals  
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**Natural capital and Human well-being: What are the links?  
A study among rural inhabitants from Kodagu district (Karnataka State),  
India.**

Memoria presentada por  
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por la Universitat Autònoma de Barcelona.

con la aprobación de los Directores de la Tesis



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\* En cumplimiento con la normativa vigente de mención de Doctor Europeo, los apartados *Abstract* y *Conclusions* están escritos en inglés.



“A Loreto, y los dos pequeñitos  
que se suman a nuestra aventura

A Cesar y Patricia, “Zorondo-Rodríguez”,  
y a mis hermanas y hermanos”

y a todos aquellos que pensaron y piensan  
en el mañana duro  
que tuvieron y que tendremos,  
a quienes pusieron y están dispuestos a poner  
más pasión, más cariño,  
...para hacer más grande y cada vez más justa,...  
...la vida.”

(basado en el “*Discurso de la Victoria*”, Salvador Allende,  
04 Septiembre 1970)



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(Althea Gibson)

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## **Abstract**

Ecosystems are proposed as sources of human well-being. However, standard economic approaches have traditionally neglected the role of natural capital (i.e. good and services of ecosystems) as a fundamental source of human well-being. Drawing on the ecosystem services approach and on the Human Scale Development paradigm as frameworks to conceptualize natural capital and human well-being, this doctoral dissertation aims to understand the relationships between human well-being and natural capital. The Thesis has three main objectives which are addressed in three different chapters. The first chapter analyses the correspondence between the measurement tool adopted by governments to assess well-being and the elements defined by local people as important in their own well-being, called here local means. The second chapter aims to assess the local perception of ecosystem services and the socioeconomic determinants affecting individual perceptions. Last, the third chapter estimates the linkages between human well-being and natural and economic capital. This third chapter also analyses the linkages of capitals with three dimensions of human well-being (i.e. subsistence, security, and reproduction and care). As case study, the Thesis focuses on a small-scale society from Kodagu district (Karnataka State), India.

The Thesis is based on cross-sectional data collected through qualitative and quantitative methods during a period of nine months. To collect data for the first chapter, free-listing technique was administrated in order to provided information on local means defining well-being among 114 individuals from Kodagu. The local means reported by local individuals were compared with the criteria used by the Human Development Report (HDR) of Karnataka, the main measurement tool of well-being used officially in Kodagu. Results suggest that HDR does not capture the means defined by people as main indicators of their well-being. The finding suggests an important gap between current well-being indicators considered by public policies and the means of well-being defined by people. For the second chapter, another free-listing was carried out to capture what ecosystem services were perceived by local people. Additionally, a structured survey was conducted to capture information on socioeconomic characteristics of 91 informants. The ecosystem services were classified into four categories of services defined by literature (i.e. provisioning, regulating, cultural, and supporting services, cf. Millennium Ecosystem Assessment). The number of services listed was calculated in each category. Results suggest that ecosystems are locally perceived as a source of multiple goods and services that go beyond the production of food (for subsistence or for cash). Multivariate regressions were used to estimate the associations between number of ecosystem services and socio-economic characteristics. Results suggest that younger, wealthier, and more educated individuals perceive more ecosystem services than people without those characteristics. People from different cultural backgrounds also have different perceptions from local ecosystems services.

For the third chapter, a questionnaire structured was designed on the base of information collected on the two previous chapters. The questionnaire was administrated to 171 adivasi and forest dweller individuals from Kodagu, different from people interviewed in previous samples. The questionnaire captured individual reports on levels of satisfaction with the overall well-being and satisfaction with three dimensions of well-being (dependent variables), and level of natural and economic capital (explanatory variables). Results of multivariate regressions suggest positive associations between well-being and both forms of capitals. Nevertheless, results also suggest that natural and economic capitals differed one from each other on their relative contributions to overall well-being as well as across dimensions of well-being. Results suggest that natural capital can become more important than economic capital

on the fulfilment of overall well-being and its dimensions among adivasi and forest dwellers society.

Last, I would like to conclude by outlining some policy suggestions. The Thesis provides insights for a set of plausible local indicators useful to achieve a balance between top-down and bottom-up approaches for the local public policies. Furthermore, since natural and economic capital play a different role as sources of satisfiers across dimensions, results give insights for possible strategies on how to complement natural and economic capital assets when designing policies to improve particular dimensions of well-being. The Thesis support ongoing calls for explicitly incorporating ecosystem services in the policy design focused on measuring and improving human well-being.

**Key words:** human well-being, natural capital, economic capital, ecosystem services, Kodagu, India.

## **Resumen**

Los ecosistemas son propuestos como fuentes de bienestar humano. Sin embargo, las aproximaciones económicas principales han descuidado este esencial papel del capital natural (i.e. bienes y servicios de los ecosistemas) en el bienestar humano. Usando como marco teórico la aproximación de los servicios ecosistémicos y el paradigma de Desarrollo a Escala Humana, el objetivo de esta tesis doctoral es entender las relaciones entre bienestar humano y capital natural. La Tesis doctoral tiene tres principales objetivos, los cuales fueron abordados en tres diferentes capítulos. El primer capítulo analiza la correspondencia entre el instrumento de medición adoptado por los gobiernos para evaluar bienestar y los elementos definidos como importantes por la gente local para su propio bienestar, llamados aquí medios locales de bienestar. El segundo capítulo tiene el propósito de evaluar las percepciones locales de servicios ecosistémicos y los factores socioeconómicos que afectarían las percepciones de las personas. Por último, el tercer capítulo evalúa los vínculos entre bienestar humano y dos formas de capital: capital natural y económico. El tercer capítulo también analiza los vínculos entre los capitales y tres dimensiones del bienestar humano (i.e. subsistencia, seguridad, y reproducción y cuidado). Como caso de estudio, la Tesis se enfoca en una sociedad a nivel local ubicada en el distrito de Kodagu (Estado de Karnataka), India.

La Tesis es basada en datos transversales recolectados a través de métodos cualitativos y cuantitativos de investigación. Para la recolección de datos del primer artículo, se desarrolló una técnica de listados libres (Free-listings) y así obtener información sobre los medios locales de bienestar. Para esto, se visitaron a 114 individuos de Kodagu. Los medios locales de bienestar reportados por los individuos fueron comparados con los criterios usados por el Informe de Desarrollo Humano (HDR, del nombre en inglés Human Development Report) del Estado de Karnataka. El HDR es la herramienta oficial de medición de bienestar usado por el gobierno de Kodagu. Se encontró que el HDR no captura los medios de bienestar definidos por las personas. El resultado sugiere que existe una importante brecha entre los actuales indicadores de bienestar considerados por las políticas públicas y los medios locales de bienestar definidos por las personas. En el segundo capítulo también se llevó a cabo listados libres para identificar los servicios ecosistémicos percibidos por las personas locales. Se visitaron a 91 individuos, todos distintos a los visitados para el primer capítulo. Además, a través de una entrevista estructurada, se recolectaron datos de atributos socioeconómicos de cada individuo participante del estudio. Los servicios ecosistémicos se clasificaron en las cuatro categorías de servicios definidos por la literatura (i.e. servicios de provisión, regulación, culturales, y de apoyo, según la clasificación de la iniciativa de Evaluación de Ecosistemas del Milenio). En base a la clasificación, se calcularon los números de servicios listados en cada categoría. Los resultados sugieren que los ecosistemas son localmente percibidos como una fuente de bienes y servicios diversos, y no sólo vinculados a la producción de alimento. Usando regresiones multivariadas para estimar las asociaciones entre el número de servicios ecosistémicos y las características socioeconómicas de los individuos, se encontró que individuos jóvenes, más ricos, y más educados perciben más servicios ecosistémicos que los individuos con características socioeconómicas diferentes. Asimismo, se encontró que orígenes culturales distintos están asociados a diferentes percepciones de los servicios ecosistémicos.

Para abordar los objetivos del tercer capítulo, se contruyó un cuestionario estructurado en base a la información de los dos capítulos previos. Se visitaron 171 individuos adivasi y habitantes de los bosques de Kodagu, todos distintos a los individuos visitados en los dos capítulos previos. El cuestionario capturó información individual sobre el nivel de bienestar general y satisfacción con las tres dimensiones de bienestar incluidas en el estudio (variables dependientes), y el nivel de capital natural y económico (variables explicatorias). Usando

modelos de regresiones multivariados, se encontró una asociación positiva entre bienestar y ambas formas de capital. No obstante, también se encontró que los capitales natural y económico varían entre ellos en relación a sus asociaciones con el bienestar general y entre las dimensiones del bienestar. Los resultados sugieren que, en sociedades de adivasis y habitantes del bosque, el capital natural puede llegar a ser más importante que el capital económico en la satisfacción del bienestar general y sus dimensiones.

Para finalizar, quisiera concluir explorando algunas sugerencias para políticas públicas. En base a los resultados, la Tesis contribuye con información para un conjunto de indicadores locales útiles que aseguren un equilibrio entre los enfoques descendentes y ascendentes en las políticas públicas de Kodagu. Además, ya que las dos formas de capital juegan un papel diferente como fuentes de satisfacción de las dimensiones de bienestar, la Tesis aporta información para posibles estrategias sobre cómo complementar el capital natural y económico cuando se diseñan políticas de mejora de particulares dimensiones del bienestar. La Tesis apoyan las recomendaciones actuales sobre la necesidad de incorporar explícitamente los servicios ecosistémicos en el diseño de políticas públicas relacionadas con medir y mejorar el bienestar humano.

**Palabras Claves:** Bienestar humano, capital natural, capital económico, servicios ecosistémicos, Kodagu, India.



## **Introducción general**

### **Planteamiento del problema: contribución del capital natural al bienestar humano**

La asociación entre bienestar humano<sup>1</sup> y los ecosistemas, conceptuados aquí como una forma de capital natural, se ha convertido en una de las nuevas piedras angulares del desarrollo sustentable, uno de los grandes desafíos del siglo XXI (Daly, 1996; Dodds, 1997). El reporte de la Comisión Brundtland (*Our Common Future*) define el desarrollo sustentable como el desarrollo que permite la satisfacción de las necesidades de generaciones presentes sin comprometer la satisfacción de las necesidades de generaciones futuras. En este sentido, el desarrollo sustentable puede ser concebido como un tipo de desarrollo que aspira al bienestar y a la equidad intergeneracional (Dasgupta, 2010). Para asegurar el bienestar de generaciones actuales y futuras es necesario entender cómo los individuos dependen de diferentes elementos – materiales y no-materiales, manufacturados y naturales – para satisfacer sus necesidades y deseos. Sin embargo, la literatura sobre bienestar se ha centrado principalmente en entender la contribución de los aspectos económicos al bienestar en detrimento de otros elementos, como los ecosistemas (Dolan et al., 2008). Este sesgo hacia el análisis de la contribución de los factores económicos en el bienestar se basa en el supuesto de que un aumento en indicadores económicos (e.g. ingreso, bienes manufacturados, PIB) está directamente asociado a un aumento en el bienestar humano (Costanza et al., 2007; Diener and Suh, 1997; Dolan et al., 2008; Easterlin, 2003; Ferrer-i-Carbonell, 2005). Como consecuencia, la mayoría de las políticas públicas orientadas a la mejora del bienestar humano se guían fundamentalmente por indicadores basados en la contribución del capital económico (e.g. PIB, índice de Desarrollo Humano, Índice de Ahorro Auténtico) para evaluar y mejorar el bienestar (Dolan et al., 2008; Hagerty et al., 2001), pasando por alto el papel que juegan los ecosistemas en el bienestar humano y desatendiendo los costes económicos, ecológicos y sociales asociados a su deterioro (Millennium Ecosystem Assessment, 2003; TEEB, 2010).

En los últimos años, investigadores de diversos campos de conocimiento han cuestionado la relevancia de factores económicos para entender el bienestar humano y han enfatizado el papel de otros determinantes del bienestar (Dodds, 1997; Easterlin, 2003; Ferrer-i-Carbonell,

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<sup>1</sup> Sin entrar en el debate epistemológico en los conceptos, pero si reconociendo diferencias en sus definiciones, a lo largo del escrito se usa el concepto de bienestar (well-being), bienestar subjetivo (subjective well-being), satisfacción de vida (life satisfaction), calidad de vida (quality of life) como sinónimos.

2005; Ferrer-i-Carbonell and Gowdy, 2007; Masferrer-Dodas et al., in press; Max-Neef, 1995). En particular, la literatura sobre el bienestar humano ha omitido la importancia de variables relacionadas con el acceso y el manejo de ecosistemas como factores fundamentales en el nivel de bienestar de las personas (Costanza et al., 2007; Dolan et al., 2008; Ferrer-i-Carbonell and Gowdy, 2007; Gómez-Baggethun and de Groot, 2010; Helliwell et al., 2012; Max-Neef, 1995; Pereira et al., 2005). La omisión de gran parte de la literatura sobre el papel de los bienes y servicios de los ecosistemas<sup>2</sup> en el bienestar humano tiene consecuencias que van más allá de la importancia teórica. El desconocimiento o falta de atención de la importancia de las variables ecosistémicas en el bienestar humano imposibilita que las políticas públicas destinadas a su mejora no pueden incluir dichas variables dentro de su diseño. Mientras los instrumentos de políticas públicas relacionados con el bienestar no incluyan variables ecosistémicas, éstos serán inadecuados para hacer operativo el concepto de desarrollo sostenible (Distaso, 2007; Fenech et al., 2003; Gómez-Baggethun and de Groot, 2010). Basado en este marco teórico, la presente Tesis doctoral tiene como objetivo general entender el papel del capital natural como fuente de satisfactores del bienestar humano, usando como caso de estudio una sociedad rural de la India.

Uno de los grandes retos de la investigación en bienestar humano es la propia definición del concepto de bienestar. Se ha sugerido que una definición idónea del bienestar humano debería tomar en cuenta la multidimensionalidad del concepto (Max-Neef et al., 1993). Más aún, una definición completa del concepto debería captar los diversos tipos de necesidades humanas, las interacciones entre ellas, y las diferentes estrategias para satisfacerlas (Alkire, 2002; Distaso, 2007; Max-Neef et al., 1993). Un enfoque multidimensional de bienestar tiene ventajas importantes en comparación con las aproximaciones unidimensionales al bienestar. Primero, los instrumentos de medición de bienestar que tienen en cuenta diferentes dimensiones permiten trascender el reduccionismo economicista de los indicadores tradicionales. Segundo, una evaluación multidimensional puede ayudar a identificar dimensiones del bienestar que no están siendo cubiertas adecuadamente. Por último, un enfoque multidimensional puede proporcionar claves que permitan elaborar estrategias de acción para mejorar el bienestar humano en sus diferentes dimensiones (Alkire, 2002). En un artículo de revisión, Alkire (2002) examina los principales modelos multidimensionales propuestos en la literatura, incluyendo el Paradigma de Desarrollo a Escala Humana (Max-Neef

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<sup>2</sup> En lo que sigue, 'bienes y servicios de los ecosistemas' serán tratados conjuntamente como 'servicios de los ecosistemas' en consonancia con el convenio adoptado por la mayoría de la literatura especializada.

et al., 1993), las Capacidades Básicas (Nussbaum, 2000), y la idea de Dominios de Calidad de vida (Cummins, 1996). Alkire sugiere que las dimensiones debieran ser irreductibles e inconmensurables, y no jerárquicas. En este sentido, se ha sugerido que uno de los marcos conceptuales más idóneos para enfocar el bienestar humano es el paradigma de Desarrollo a Escala Humana de Manfred Max-Neef (Alkire, 2002; Costanza et al., 2007; Cruz et al., 2009; Max-Neef et al., 1993), y es este el marco teórico que se adopta en esta Tesis doctoral.

EL paradigma de Desarrollo a Escala Humana (DEH) fue desarrollado por Manfred Max-Neef y colaboradores durante la década de 1980 (Max-Neef et al., 1993). Su objetivo principal fue ofrecer una alternativa a los denominados “países en vías de desarrollo” y proponer estrategias para un desarrollo consistente con las realidades ambientales, sociales, y económicas de los habitantes en estos países. El DEH enfatiza que el mejor proceso de desarrollo es aquel que mejora el bienestar de las personas de una manera coherente con el ambiente en el que viven (Max-Neef et al., 1993). En este sentido, realiza la necesidad de llegar a un equilibrio entre los enfoques descendentes (*top-down*) y ascendentes (*bottom-up*). Para este paradigma, las dimensiones del bienestar humano, que reciben la denominación de *Necesidades Humanas Fundamentales*, son finitas, universales, y clasificables. Según el DEH, los humanos satisfacen estas necesidades básicas a través de diversos elementos, denominados *satisfactores*. Para Max-Neef, las necesidades básicas son comunes entre culturas y periodos históricos pero no así los satisfactores, que cambian según los contextos ecológicos, sociales, y económicos. Las necesidades humanas no son independientes, sino que hay complementariedades y compensaciones entre ellas, así como una articulación interdependiente para su satisfacción (Cruz et al., 2009; Max-Neef et al., 1993). De acuerdo a los postulados del DEH, tal y como fue formulado originalmente y con contribuciones posteriores de otros investigadores (e.g. Costanza et al., 2007), las necesidades fundamentales son la subsistencia, la reproducción y el cuidado de los seres cercanos, la seguridad, el afecto, el entendimiento, la participación, el ocio, la espiritualidad, la creatividad, la identidad, y la libertad. El DEH incluye explícitamente el contexto ecológico dentro de su postulado, argumentando que el desarrollo de toda sociedad debiera ser contextualizado según los límites biofísicos imperantes en un sistema ecológico dado (Cruz et al., 2009; Dodds, 1997; Max-Neef et al., 1993). Trabajando sobre la base del paradigma del DEH, Costanza et al (2007) sugieren que los satisfactores de las necesidades humanas provienen de cuatro formas de capital (i.e. natural, económico, social, y humano). En un estudio en varios países, Vemuri y Costanza (2006) encontraron que los reportes promedios de bienestar son determinados, principalmente, por variables de capital natural, económico y humano. Es más, Costanza et al.

(2007) ponen un énfasis especial en el capital natural como fuente de satisfactores, y señalan que entender el nivel y calidad de los satisfactores brindados por el capital natural y sus efectos sobre las necesidades y el bienestar general son aspectos que requieren inmediata investigación.

Conscientes de los riesgos e implicaciones prácticas que conlleva la conceptualización de la naturaleza como una forma de capital (Gómez-Baggethun et al., 2010), pero también de su potencial transformador para vincular el análisis económico con la consideración de los límites biofísicos de los ecosistemas (Gómez-Baggethun and de Groot, 2010; Gómez-Baggethun et al., 2010), la presente Tesis centra su análisis en la contribución del capital al bienestar humano. El concepto de capital natural incluye los bienes renovables y no-renovables y los servicios que los ecosistemas proporcionan a las sociedades humanas (cf. Daly, 1994). Uno de los marcos teóricos más completos para entender los bienes y servicios que los ecosistemas proporcionan a la sociedad, a diferentes escalas, es el propuesto por la Evaluación de Ecosistemas del Milenio (MEA, en sus siglas abreviadas en inglés) (Carpenter et al., 2009; Daily and Matson, 2008; Fisher et al., 2009; Millennium Ecosystem Assessment, 2003; Wallace, 2007). Un valor añadido del MEA sobre otros marcos teóricos precedentes es su capacidad para conectar disciplinas que estudian diferentes aspectos de los sistemas socio-ecológicos, tales como la ecología, la economía, la biología de la conservación, la política ambiental, y la antropología. En consecuencia, el marco teórico del MEA ha sido ampliamente adoptado por científicos y políticos, y ha estimulado nuevas líneas de investigación en bienestar humano, la economía ecológica, la biología de la conservación, y el desarrollo social (Daily and Matson, 2008). La economía ecológica y el MEA reconocen el capital natural como una fuente fundamental de satisfactores de bienestar humano, pero también postula que otras formas de capital -como el capital económico, el capital social, y el capital humano- se complementan para lograr la satisfacción de las necesidades humanas y el desarrollo social.

Dado que todas estas líneas de investigación son relativamente recientes, todavía hay una comprensión limitada acerca de cómo los diferentes tipos de capital se complementan, solapan e interfieren en la consecución de un modelo de desarrollo favorable para las generaciones actuales y futuras (Costanza et al., 2007). Asegurar la satisfacción de las necesidades fundamentales del ser humano, actuales y futuras, requiere tomar decisiones sobre qué aspectos ambientales deberían ser preservados y bajo qué forma (Costanza et al., 2007; Dodds, 1997; Max-Neef et al., 1993). Un paso clave para avanzar hacia la sostenibilidad es entender porqué determinados servicios de los ecosistemas son importantes para el

bienestar humano, y cómo se pueden estructurar las instituciones económicas y sociales para hacer un buen uso del capital natural y de otras formas de capital (Dodds, 1997). Más aún, se ha sugerido que el papel de cada forma de capital es diferente según las diferentes dimensiones del bienestar, y se ha enfatizado que el capital natural tiene un papel en la satisfacción de todas las dimensiones, con especial contribución a la dimensión de subsistencia (Costanza et al., 2007). A pesar de este supuesto, gran parte de la literatura sobre bienestar humano se sigue basando en indicadores de satisfacción de vida general, y existen pocos antecedentes empíricos que analicen cómo las diferentes dimensiones del bienestar son satisfechas por diferentes formas de capital. Por tanto, existe una laguna en el conocimiento empírico a cerca de la contribución del capital natural a las diferentes dimensiones del bienestar humano. El avance de este conocimiento permitiría entender los modos específicos de contribución del capital natural al bienestar humano, y en consecuencia, formular políticas públicas concretas que vinculen el bienestar y el manejo de ecosistemas.

### **Contribución del capital natural al bienestar humano: conocimientos y limitaciones**

La literatura existente sobre las relaciones entre el capital natural y el bienestar humano se centra en aspectos teóricos más que empíricos (Costanza et al., 2007; Dodds, 1997). El MEA sugiere que los servicios de los ecosistemas contribuyen directa e indirectamente a varios aspectos del bienestar humano (Millennium Ecosystem Assessment, 2003). Por ejemplo, los ecosistemas contribuyen mediante la cobertura de necesidad materiales básicas para el sustento de las personas (i.e. alimentos, madera, leña, entre otros). Pero los ecosistemas también proporciona elementos no-materiales (i.e. religiosos, relaciones sociales, estéticos, entre otros) que contribuyen al bienestar humano (Millennium Ecosystem Assessment, 2003). A pesar de que esta premisa está ampliamente aceptada en la literatura especializada, muy pocos estudios han analizado datos empíricos respecto a la asociación entre bienestar y factores ecosistémicos (Dolan et al., 2008). Por ejemplo, el World Happiness Report, un informe sobre los diferentes factores que influyen en el bienestar humano, señala que el clima y la calidad del aire han sido los servicios ecosistémicos más estudiados en relación a su contribución al bienestar humano (Helliwell et al., 2012). De forma parecida, en una revisión de la literatura económica desde 1990, Dolan y colaboradores (2008) detallan que de entre los muchos servicios ecosistémicos que potencialmente podrían influir en el bienestar humano, fundamentalmente se han estudiado aspectos relacionados con la contaminación (Welsch,

2002, 2006) u otros problemas ambientales (Ferrer-i-Carbonell and Gowdy, 2007), y con condiciones meteorológicas extremas (Rehdanz and Maddison, 2005).

Además la mayor parte de la escasa evidencia empírica disponible sobre las relaciones entre factores ecosistémicos y bienestar humano se ha centrado casi exclusivamente en sociedades de tipo “occidental”. Más aún, estas investigaciones se han realizado generalmente a escala regional o nacional, con poca atención a la escala local (i.e. Abdallah et al., 2008; Vemuri and Costanza, 2006). Puesto que las relaciones entre ecosistemas y sociedad pueden cambiar entre distintos grupos sociales y escalas espaciales (Hein et al., 2006; Millennium Ecosystem Assessment, 2003), las investigaciones previas únicamente proporcionan un conocimiento parcial sobre las mismas. En consecuencia, se ha planteado que junto a la importancia de encontrar patrones generales, también es necesario realizar estudios más locales, capaces de reflejar las particularidades de distintas culturas en diferentes contextos geográficos (Kontogianni et al., 2010).

Parece lógico pensar que la asociación entre capital natural y bienestar humano es particularmente relevante en sociedades que tienen una estrecha relación con los ecosistemas, tal como sociedades rurales o indígenas. A menudo, la subsistencia de estas sociedades dependen directamente de la biodiversidad local –i.e. en términos de servicios ecosistémicos- y son las más afectadas por la degradación de los ecosistemas (Folke et al., 2005; Millennium Ecosystem Assessment, 2003). Además, estas sociedades normalmente tienen un papel importante en la gestión de la biodiversidad local de la cual dependen (Byers et al., 2001; Dominguez et al., 2010). De hecho, las sociedades rurales e indígenas a menudo satisfacen muchos de sus requerimientos nutricionales, de salud, económicos, y culturales gracias al aprovechamiento de los servicios ecosistémicos locales (Folke et al., 2005; Kusters et al., 2006; Pereira et al., 2005). A pesar de la mayor dependencia relativa de estas sociedades en los bienes y servicios ecosistémicos locales, ha habido poca investigación centrada en el efecto de los factores ecosistémicos sobre el bienestar humano en este tipo de sociedades. Entre la escasa investigación en el tema destaca, por ejemplo, el trabajo de Masferrer-Dodas y colaboradores (en prensa) en la sociedad indígena Tsimane’ de la amazonía boliviana. Estos autores no encuentran ningún tipo de asociación entre el nivel de bienestar de las personas y su ingreso económico y riqueza material, sugiriendo que el bienestar de estas sociedades está asociado a otros factores, como el aprovechamiento de los ecosistemas locales. En otra investigación sobre el tema, Pereira y colaboradores (2005) encuentran que el bienestar de habitantes de sociedades rurales de Portugal depende estrechamente de la oportunidad de

acceso y uso de servicios ecosistémicos de provisión tales como alimentación, combustible, plantas medicinales y otros. Sin embargo, al contrario de los resultados en Bolivia y Portugal, en una investigación en una comunidad aborígen de Malasia Howell et al. (2006) encuentran que el bienestar de la gente de esta comunidad depende estrechamente de sus niveles económicos, y que los niveles de dependencia son mayores que lo normalmente encontrado en sociedades occidentales. La disparidad reflejada por estos resultados sugiere que las evidencias empíricas sobre las asociaciones entre ecosistemas y el bienestar humano en las sociedades rurales e indígenas no ha sido concluyente hasta ahora.

## **Caso de estudio: Kodagu**

### **Antecedentes generales**

En esta Tesis se estudian las relaciones entre capital natural y bienestar humano en una sociedad rural del distrito de Kodagu, en el sur de la India. Kodagu es también conocido como Coorg y está ubicado al sur-oeste del estado de Karnataka, India (75°25' - 76°14' E, 12°15'-12°45' N, Fig. a). Kodagu tiene una población total de 548.561 habitantes, de los que un 13% vive en ambientes urbanos (Censo 2001). Kodagu se subdivide administrativamente en tres *taluks*: Madikeri, Virajpet, y Somwarpet. La investigación se centró particularmente en el *taluk* de Virajpet. Cada *taluk* tiene bajo administración un conjunto de gobiernos locales llamados *Panchayats*. Los *Panchayats* son los organismos encargados de conducir las demandas, aspiraciones, necesidades, y opiniones de sus habitantes hacia instituciones gubernamentales superiores, de forma que estas demandas puedan ser incluidas en el diseño de políticas de desarrollo humano (Government of Karnataka, 2006). Para complementar este proceso participativo, el gobierno de la India ha creado los *gram sabhas*, o espacios de participación popular. No obstante el gobierno ha reconocido que el funcionamiento de estas instituciones a menudo no es ni democrático ni participativo. Así por ejemplo, un informe de Desarrollo humano (2006) puntualiza que las personas pobres, las mujeres y los individuos de castas bajas son comúnmente marginados de los *gram sabhas* y no logran hacer llegar sus opiniones a las instituciones gubernamentales superiores.

La población de Kodagu, al igual que la de toda la India, tiene diferentes orígenes culturales. El gobierno indio agrupa a los individuos en tres grandes grupos sociales: Scheduled tribes (ST), Scheduled castes (SC), y Other Backward Castes (OBC). Los ST y SC son los grupos reconocidos como las castas bajas, y el grupo OBC como el de castas altas. Los ST, o Adivasis, son las tribus

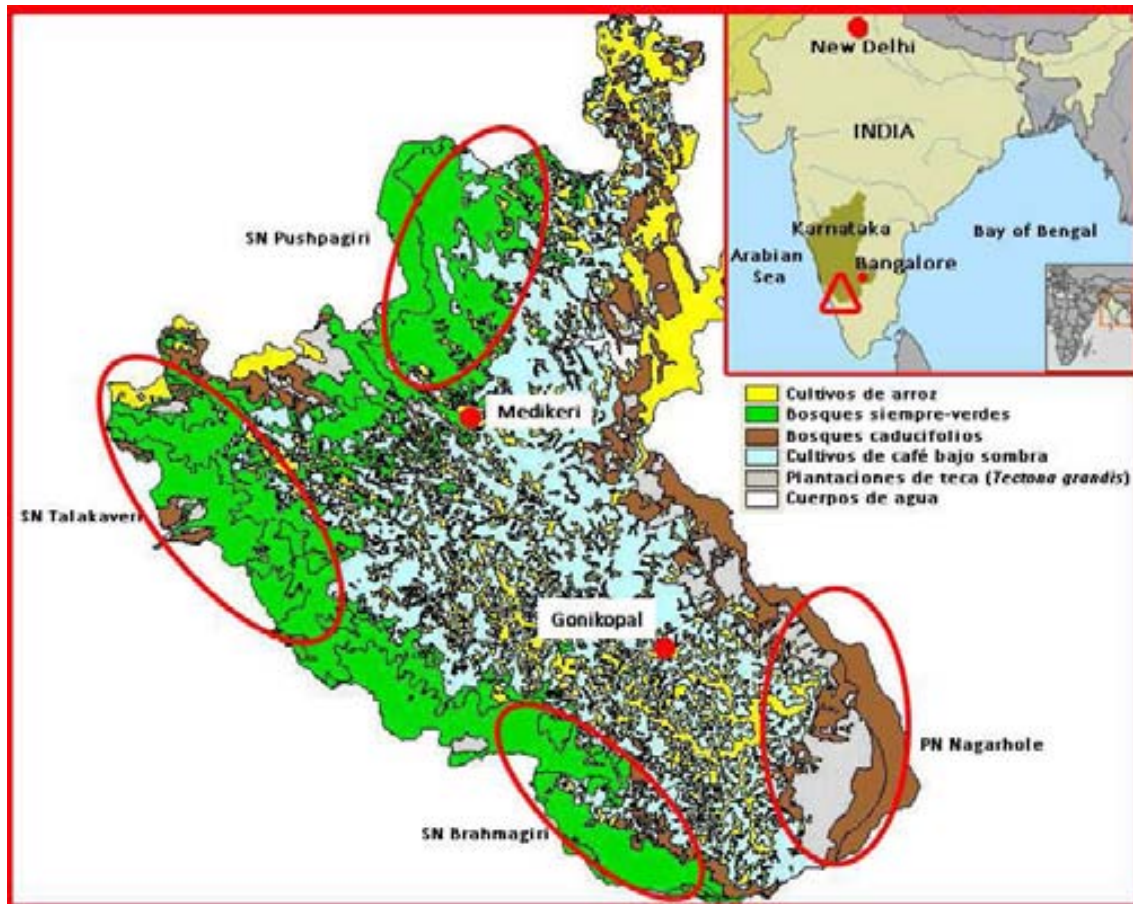


Figura a. Sitio de Estudio: Distrito de Kodagu, Estado de Karnataka, India. La figura muestra la distribución de bosque siempre-verde, caducifolio, cultivos de café, y la ubicación aproximada de los santuarios de la naturaleza (SN) y el parque nacional (PN).

aborígenes y en el caso de Kodagu están representadas mayoritariamente por las tribus Jenu-Kurubas, Betta-Kurubas, y Soligas. Por su parte, los SC en Kodagu incluyen a personas pertenecientes a los grupos Panikas y Parivaras. EL grupo OBC están representado principalmente por Kodovas y Gowdas. Según el censo 2001, un 12,4% de la población de Kodagu pertenece a SC y un 8,4% a los ST (Government of Karnataka, 2006). El sistema de castas indio está fuertemente asociado a los diferentes privilegios de los individuos. Los ST y SC representan el grupo de castas que históricamente han recibido menos privilegios sociales, políticos, y económicos dentro de la población India. Un cuarto grupo social corresponde a las personas que están fuera del sistema de castas, principalmente porque profesan religiones diferentes de la hindú, como los musulmanes y los católicos.

La población de Kodagu habita en asentamientos que pueden ser clasificados en tres tipos. Primero, las zonas urbanas, o pueblos con más de 2000 habitantes. En estos, las casas se



encuentran agrupadas y normalmente cuentan con servicios básicos como escuelas, mercados, transporte público, asistencia de salud, comisaría de policía, y oficina postal. En las zonas rurales se pueden encontrar los otros dos tipos de asentamientos: comunidades y colonias tribales. Las comunidades son asentamientos con menos de 2000 habitantes, en los que las casas se encuentran normalmente dispersas, y disfrutan sólo de algunos servicios básicos (usualmente escuela primaria, pequeñas tiendas y oficina postal). La mayoría de los agricultores del café, el principal producto agrícola de la zona, vive en este tipo de comunidades. El segundo tipo de asentamiento en zonas rurales son las colonias de Adivasis. Estas colonias han sido establecidas por el gobierno para las personas de castas bajas. A menudo, estas colonias carecen de los servicios más básicos. Las características demográficas y culturales varían entre las colonias ubicadas dentro del bosque y aquellas ubicadas fuera del bosque. Los habitantes de colonias establecidas dentro del bosque, lejos de áreas urbanas y de los productos tecnológicos que caracterizan las zonas modernas, aún mantienen en gran medida su estilo de vida original, su cultura, y sus tradiciones (Demps et al., 2012; Kshirsagar and Singh, 2001). Por su parte, los habitantes de las colonias cercanas a zonas urbanas están más inmersos en el sistema de mercado local y a menudo dependen de sus trabajos con el departamento forestal o en plantaciones de café para su ingreso económico (Demps et al., 2012; Laval, 2008).

### **Capital económico en Kodagu**

Kodagu es uno de los distritos de mayor poder adquisitivo del estado de Karnataka. Entre los años 2001 y 2002, Kodagu generó un producto interior bruto per capita de 24.200 Rupias Indias (INR) (1 € = 62.5 INR, Febrero 2010), siendo el tercer distrito con más alto producto interior bruto de Karnataka (Government of Karnataka, 2006). La economía de Kodagu se basa principalmente en la agricultura y, en particular, en la producción de café. La región produce alrededor del 2% de la producción mundial de café (Coffee Board of India, 2008). La mayor parte de los individuos de Kodagu están conectados, de alguna u otra forma, con la producción de café.

La riqueza económica de Kodagu está desigualmente distribuida entre sus habitantes. A menudo, los individuos pertenecientes al grupo OBC son los propietarios de las plantaciones de café y concentran la mayor parte de la riqueza económica. Los individuos que pertenecen a las SC y ST son empleados de los OBC, y trabajan en el mantenimiento y la cosecha de café. Según nuestras observaciones en terreno, el día de trabajo es pagado entre 100 y 150 INR, y no existe ninguna condición de contrato laboral. Otra fuente de ingreso económico para los SC

y ST son la construcción de caminos y el manejo de bosques con el Departamento Forestal de Karnataka.

La riqueza económica de SC y ST también varía entre colonias ubicadas fuera y dentro del bosque. Debido a que existe una serie de dificultades institucionales, geográficas, y económicas para facilitar servicios básicos (i.e., agua, electricidad) dentro de las áreas ubicadas dentro de los bosques protegidos, las familias de colonias ubicadas dentro de los bosques presentan una riqueza económica menor que aquellas familias que están fuera de las zonas boscosas. Por ejemplo, en nuestras observaciones de campo evidenciamos que muchas de las casas dentro del bosque son chozas fabricadas con barro y material vegetal (Demps et al., 2012; Demps et al., in press), mientras que la mayoría de las casas fuera del bosque están construidas con materiales más sólidos adquiridos en el mercado. Los servicios básicos también difieren entre colonias. En muchas ocasiones, las colonias dentro del bosque no tienen acceso a servicios básicos tales como bombas de agua, electricidad, y baños.

### **Capital natural en Kodagu**

Kodagu está ubicado entre las montañas denominadas “Western Ghats”. El paisaje de Kodagu está caracterizado por tres eco-zonas principales. La zona agrícola domina el centro del distrito, mientras que los remanentes de bosque nativo, tanto bosques siempre-verdes como bosques caducifolios, están ubicados a ambos lados del distrito (Fig. a). Hoy en día, la zona agrícola cubre un 60% de la superficie total del distrito y está cubierta principalmente por cultivos de café sembrados bajo el dosel de bosque nativo. Junto a la producción de café, los agricultores locales también producen pimienta, aprovechando los troncos de los árboles nativos. Otros cultivos importantes en el distrito son los arrozales, y las plantaciones de jengibre y cardamomo.

Los bosques siempre-verdes y caducifolios son parte de los remanentes de la amenazada biodiversidad tropical de los Western Ghats. Actualmente, estos bosques cubren aproximadamente un 30% de la superficie del distrito. Los bosques siempre-verdes están ubicados en la franja occidental del distrito, mientras que los bosques caducifolios están ubicados en la franja oriental. Estos bosques mantienen una rica y endémica diversidad biológica, la cual ha sido fuertemente perturbada por fuertes actividades antrópicas. Hoy en día, estos bosques, y el resto de los Western Ghats, han sido definidos como uno de los sitios con mayor prioridad de conservación biológica en el mundo (Myers et al., 2000). Los bosques de Kodagu albergan poblaciones significativas de varias especies en estado crítico de conservación, entre las que destacan el tigre de bengala (*Panthera tigris*), el elefante asiático

(*Elephas maximus*), el leopardo (*Panthera pardus*), el bisonte indio (*Bos gaurus*), los perros salvajes (*Cuon alpinus*), y el macaco de cola de león (*Macaca Silenus*).

Respecto a las relaciones entre personas y los ecosistemas, tres aspectos son dignos de mención. Primero, las culturas aborígenes aún mantienen un rico conocimiento ecológico tradicional. Por ejemplo, la cultura Jenu-Kuruba, fuertemente asociada a la recolección de miel (*jenu*, en la lengua local significa miel), continúa manteniendo las tradiciones de recolección, incluyendo los rituales y canciones asociadas a las actividades de recolección tradicional (Demps et al., 2012; Demps et al., in press). Segundo, debido a la solapamiento de asentamientos humanos y zonas de alta diversidad biológica, las personas de Kodagu con frecuencia están inmersas en diversos conflictos ambientales. Por ejemplo, en la zona de estudio anualmente se documentan ataques de elefantes, tigres, leopardos y serpientes a visitantes del bosque o incluso a los propios asentamientos (Bal et al., 2011; Laval, 2008). El tercer aspecto a remarcar de las relaciones de la población local de Kodagu con los ecosistemas adyacentes es la persistencia de la recolección de diversos recursos naturales y el aprovechamiento de servicios ecosistémicos del bosque, a pesar de las restricciones impuestas por las autoridades ambientales. Por ejemplo, Kshirsagar y Singh (2001) registraron una lista de 78 plantas medicinales distintas comúnmente recolectadas entre las tribus de la zona.

Un aspecto interesante a destacar son las políticas ambientales que regulan el aprovechamiento de recursos y servicios ecosistémicos del bosque. Por ejemplo, la política de manejo forestal en la India considera a los bosques nativos de la zona bajo la figura de "Bosques Reservados". Los bosques clasificados bajo esta figura tienen el grado completo de protección y todas las actividades productivas están prohibidas en su interior, excepto si son expresamente autorizadas (Forest Survey of India, 2009). Los bosques protegidos fueron creados por el Acta Forestal de India de 1878. El proceso de "protección" de los bosques fue un proceso largo y complejo, que incluyó la identificación, registro y compensación de todos los derechos pre-existentes sobre los bosques a preservar (Saravanan, 2009). Parte de estos bosques son administrados mediante una red de áreas protegidas formales consistente en tres Santuarios de Vida Silvestre y un parque nacional. Los tres santuarios de vida silvestre (Brahmagiri, Talakaveri, y Pushpagiri) protegen los bosques siempre-verdes de la franja occidental de Kodagu y el Parque Nacional Nagarhole alberga los bosques caducifolios del sector este. Los bosques protegidos y las áreas protegidas establecidas en ellos están bajo la administración del Departamento Forestal de Karnataka.

Además de la red formal de áreas protegidas y de las regulaciones ambientales, existen también espacios de conservación que se han originado por instituciones informales y que posteriormente han sido reconocidos como bosques bajo protección oficial, tales como los bosques sagrados. Kodagu presenta alrededor de 1200 fragmentos de 'bosques sagrados,' conocidos localmente como *devarakadu* (*devara* = dios y *kadu* = bosque) (Ormsby, 2011). Estos bosques, esparcidos en la zona agrícola y los bosques nativos, actualmente están reconocidos por la ley forestal de Karnataka. Gran parte de estos bosques sagrados se han mantenido a pesar de los fuertes cambios en el paisaje que ha experimentado Kodagu, y las fuertes demandas sobre los recursos naturales que estos bosques albergan (Bhagwat et al., 2005a; Bhagwat and Rutte, 2006; Ormsby, 2011). No obstante, el nivel de protección que otorgan los bosques sagrados no es el mismo que el que proporcionan las figuras formales de conservación estricta (Bhagwat et al., 2005a; Bhagwat and Rutte, 2006; Garcia et al., 2009). Además de su evidente relevancia cultural, los bosques sagrados juegan un papel importante en la conservación de la diversidad biológica de Kodagu. Estos bosques son reconocidos como importantes refugios de biodiversidad local y permiten aumentar la conectividad ecológica para el beneficio de diversas especies (Bhagwat et al., 2005a, b; Bhagwat and Rutte, 2006; Garcia et al., 2009).

Además de establecer áreas dedicadas a la protección de la biodiversidad, las autoridades de la India también regulan el aprovechamiento de servicios ecosistémicos (principalmente, servicios de aprovisionamiento) dentro y fuera de los bosques preservados y áreas protegidas. Esta regulación se hace, a través de, por ejemplo, permisos de recolección de recursos naturales específicos, establecimiento de distintos tipos de tenencia de la tierra, y de derechos de acceso a recursos forestales. Así, la recolección y comercialización de productos forestales 'menores' (i.e. miel, líquenes, y algunos frutos) es permitida sólo para aquellos adivasi que tienen licencia de recolección. Estas licencias son emitidas por las sociedades cooperativas de comercialización, llamadas Large Scale Adivasi Multi-Purpose Societies (LAMPS), y creadas por el gobierno para promover el sustento de los hogares tribales mediante el aprovechamiento controlado de recursos forestales. Por su parte, los tipos de tenencias de tierra fijan los derechos y privilegios sobre la tierra que poseen los individuos y además denotan las relaciones entre estos y el gobierno. Dependiendo del tipo de título de la tierra, los agricultores o bien tienen únicamente derecho a establecer cultivos o también a aprovechar otros recursos ubicados en sus tierras, tales como los árboles existentes en sus predios. El caso de individuos viviendo en colonias adivasi es diferente. Puesto que las colonias están establecidas en tierras con título de propiedad del estado (llamadas Paisari), los individuos que

las habitan no tienen los derechos ni privilegios para cultivar ni hacer uso de los recursos naturales ubicados en estas tierras (Uthappa, 2004).

Sin embargo, es importante señalar que los derechos sobre la tierra y los recursos forestales de los adivasi y otros habitantes tradicionales de los bosques están en un periodo de cambio desde la implementación de la nueva reforma de los Derechos del Bosque (*Scheduled Tribes and Other Traditional Forest Dwellers -Recognition of Forest Rights- Act, 2006*). Esta reforma reconoce y confiere los derechos del bosque y ocupación en tierras forestales a las comunidades tribales y otros habitantes tradicionales quienes han residido en estos bosques por generaciones (Saravanan, 2009). Específicamente, esta reforma reconoce derechos individuales y comunales sobre la tenencia, ocupación, acceso, recolección, uso, y protección de diferentes espacios y elementos de los bosques. La reforma también reconoce los derechos de propiedad y conocimiento tradicional que poseen los grupos tribales. En el momento de escribir esta Tesis, existe un importante debate en torno a si la nueva reforma de derechos forestales va a contribuir a la reducción de la pobreza y la conservación de la biodiversidad de forma simultánea. Por ejemplo, Saravanan (2009) afirma de forma enfática que, puesto que la reforma no incluye una devolución de las tierras arrebatadas a los adivasi y en consecuencia no aborda el problema de la tenencia de la tierra, la reforma no puede solucionar los problemas de bienestar de comunidades tribales ni permitir una mejora de la conservación biológica. Por su parte, Springate-Baginski y colaboradores (2009) puntualizan que el éxito de la reforma es incierto debido principalmente a las dinámicas de poder que existen en la institución forestal india. En este sentido, nuestros análisis en estudios previos sugieren que un mayor conocimiento sobre los derechos que otorga la nueva reforma forestal y las buenas relaciones con el Departamento Forestal de Karnataka estarían asociados a actitudes positivas de los habitantes del bosque hacia los bosques reservados (Macura et al., 2011).

### **Calidad de vida**

La evolución de los aspectos relacionados con el bienestar humano en la India es paradójica. El Banco Mundial destaca que, a pesar del acelerado crecimiento económico, del progreso en la mayoría de los Objetivos de Desarrollo del Milenio, y de ser la cuarta economía más grande del mundo, India aún enfrenta grandes desafíos para reducir los indicadores de pobreza económica (World Bank, 2011). Según los datos del Banco Mundial (2011), el 37% de la población india (o sobre 410 millones de personas) aún se sitúa por debajo la línea de pobreza, albergando un tercio de la pobreza mundial. Por su parte, las estimaciones sobre niveles de bienestar humano subjetivo sugieren que los habitantes de la India se acercan al punto medio

de las escalas utilizadas. Por ejemplo, la Base de Datos Mundial de Felicidad (World Database of Happiness) señala que la India tiene un valor promedio de 5.5 en un rango entre 0 y 10 (Veenhoven, 2012). Otras evaluaciones realizadas por Abdalah y colaboradores (2008) elevan el bienestar subjetivo a un valor de 5.9 en la misma escala. Es más, las puntuaciones en bienestar subjetivo en la India sugieren una tendencia positiva en los últimos 50 años, comenzando con una puntuación de 3.4 en 1962 y llegando a una puntuación de 5.5 en 2010 (Veenhoven, 2012). Sin embargo, los mismos investigadores coinciden en que las estimaciones de bienestar subjetivo a nivel nacional podrían estar sobreestimadas puesto que estas estimaciones se hacen usando encuestas que representan a un bajo porcentaje de individuos en áreas rurales o sin acceso a vías de comunicación (Abdallah et al., 2008; Veenhoven, 2012). Más aún, es evidente que en países como la India, con una alta heterogeneidad cultural, económica, y política, los promedios a nivel nacional son difíciles de interpretar, puesto que hay grandes diferencias internas, y por tanto se necesitan más investigaciones que aborden el tema a escala local.

El Estado de Karnataka publica un informe de Desarrollo Humano donde analiza diferentes indicadores objetivos de bienestar para cada distrito del Estado (Government of Karnataka, 2006). Este informe es el instrumento en el que se basa fundamentalmente el gobierno para diseñar las políticas de bienestar. Por tanto, el informe y el conjunto de indicadores incluidos en él, reflejan el concepto de bienestar que maneja el gobierno de Karnataka. En este contexto, existen dos instituciones claves que atienden las demandas de los dos grupos sociales menos privilegiados en Kodagu: la oficina de Bienestar Tribal y la oficina de Bienestar Social, que ejecutan las políticas de desarrollo humano para personas ST y SC respectivamente. Estas instituciones han desarrollado diferentes iniciativas que tienen por objetivo mejorar aspectos del bienestar de estos grupos, principalmente aspectos relacionados con educación y economía (Director de la Oficina de Bienestar Tribal de Kodagu, com. Pers).

De acuerdo a los indicadores considerados en el informe de desarrollo humano, el distrito de Kodagu es el cuarto distrito con mejores índices de desarrollo humano entre los 27 distritos de Karnataka (Government of Karnataka, 2006). En concreto, el Informe de Desarrollo Humano señala que Kodagu es uno de los distritos con mayor riqueza económica de Karnataka y describe que entre los años 1999 y 2001 sólo el 4.9% de la población se situaba bajo la línea de la pobreza (Government of Karnataka, 2006). Kodagu también destaca en los índices de alfabetización (78% de la población), escolarización (91% de los niños), e inmunización de niños (96% de los niños entre 12 y 23 meses). Sin embargo, el informe también señala que

algunos indicadores de bienestar aún necesitan ser mejorados sustancialmente. Por ejemplo, Kodagu aún sufre de una alta tasa de mortalidad infantil y se estima que hay 62 muertes de entre cada 1000 niños nacidos. El porcentaje de hogares con acceso a servicios básicos, tales como agua potable, electricidad y baños, no supera el 40%, pero además hay una gran disparidad entre zonas urbanas (70% de cobertura) y zonas rurales (36%). Asimismo, el informe también señala que hay desigualdades preocupantes entre géneros y castas en indicadores como la alfabetización, la educación, y el empleo (Government of Karnataka, 2006).

### **Objetivos y estructura de la Tesis doctoral**

El cuerpo principal de esta Tesis doctoral está conformado por un compendio de tres manuscritos preparados como artículos científicos para su publicación. Cada uno se presenta como un capítulo distinto. Debido a este formato, parte de la información, particularmente vinculada a la descripción del sitio de estudio, se repite entre los capítulos.

La Tesis doctoral tiene como objetivo general avanzar en la comprensión de las relaciones entre bienestar humano y capital natural en el contexto de las sociedades rurales. Para realizar este análisis, utilizo como caso de estudio la sociedad del distrito de Kodagu en el estado de Karnataka, en la India. En particular, la Tesis tiene tres objetivos específicos, y cada uno es desarrollado en cada uno de los capítulos presentados a continuación:

(i) En el primer capítulo, titulado *“What Defines Quality of Life? The Gap Between Public Policies and Locally Defined Indicators Among Residents of Kodagu, Karnataka (India)”* se evalúa la correspondencia entre las actuales políticas adoptadas por el gobierno de Karnataka para estimar el bienestar humano y los criterios de bienestar definidos por la población local. Este capítulo ha sido publicado en la revista *Social Indicator Research* (2012, DOI: 10.1007/s11205-012-9993-z), revista científica especializada en temas de bienestar humano.

(ii) El segundo capítulo se titula *“Perception of Ecosystem Services and its Determinants: a Case of Study among People from Western Ghats, India”* y explora los diferentes beneficios materiales y no materiales que la gente percibe desde los agroecosistemas de los Western Ghats. Además de identificar un conjunto de servicios generados por los ecosistemas, el capítulo también analiza los factores socioeconómicos y culturales que explican diferencias en las percepciones sobre el conjunto de servicios ecosistémicos. Este capítulo será próximamente enviado a la revista *Society and Natural Resources*.

(iii) En el tercer capítulo, que lleva por título “*The Role of Natural and Economic Capital on Subjective Well-being: Empirical Evidence from a Small-Scale Society from Kodagu (Karnataka), India*”, se construye sobre los resultados obtenidos los capítulos previos, para analizar las contribuciones del capital natural y económico al bienestar humano. Este tercer capítulo estima cuantitativamente i) las asociaciones entre el capital natural y económico y el bienestar humano en su conjunto (cf. Easterlin, 2003) y ii) las relaciones de cada una de estas formas de capital con tres de las dimensiones del bienestar humano: subsistencia, seguridad, y reproducción y cuidados (cf. Costanza et al., 2007; Max-Neef et al., 1993). Este capítulo será próximamente enviado a la revista *Ecological Economics*.

La Tesis culmina con una discusión general y conclusiones donde reflexiono sobre los resultados obtenidos en los tres capítulos y presento las conclusiones generales de la investigación. Por último, en la sección de anexo describo las colaboraciones institucionales y redes de co-autoría asociadas al desarrollo de la Tesis doctoral, y presento algunas imágenes de la zona de estudio.

### **Estrategia metodológica**

Como estrategia de investigación complementé un enfoque inductivo con un enfoque deductivo. Durante la recogida de datos para esta Tesis, utilicé primero un enfoque inductivo que me permitió capturar información cualitativa y así entender los conceptos locales de bienestar humano y capital natural. Para capturar información cualitativa, me basé en la teoría del consenso cultural y llevé a cabo la técnica de listados libres (Borgatti, 1996; Puri, 2011). En dos muestras de individuos distintos identifiqué elementos asociados a bienestar (114 individuos) y capital natural (91 individuos) más prominentes para las personas locales. Para esta fase dediqué cinco meses de trabajo de campo continuo (Noviembre 2008 a Abril 2009) (Fig. b). Esta información cualitativa está analizada en los capítulos 1 y 2 de la Tesis. Basado en esta información, identifiqué indicadores de bienestar y de tres de sus dimensiones (i.e. subsistencia, seguridad, reproducción y cuidado). También capturé indicadores de capital natural y económico. Con los indicadores diseñé un cuestionario estructurado y lo apliqué entre 171 individuos seleccionados al azar y diferentes de las muestras anteriores (Fig b). Con el cuestionario, capturé variables individuales cuantitativas relacionadas con i) bienestar general y satisfacción con cada una de las tres dimensiones del bienestar, ii) las dos formas de



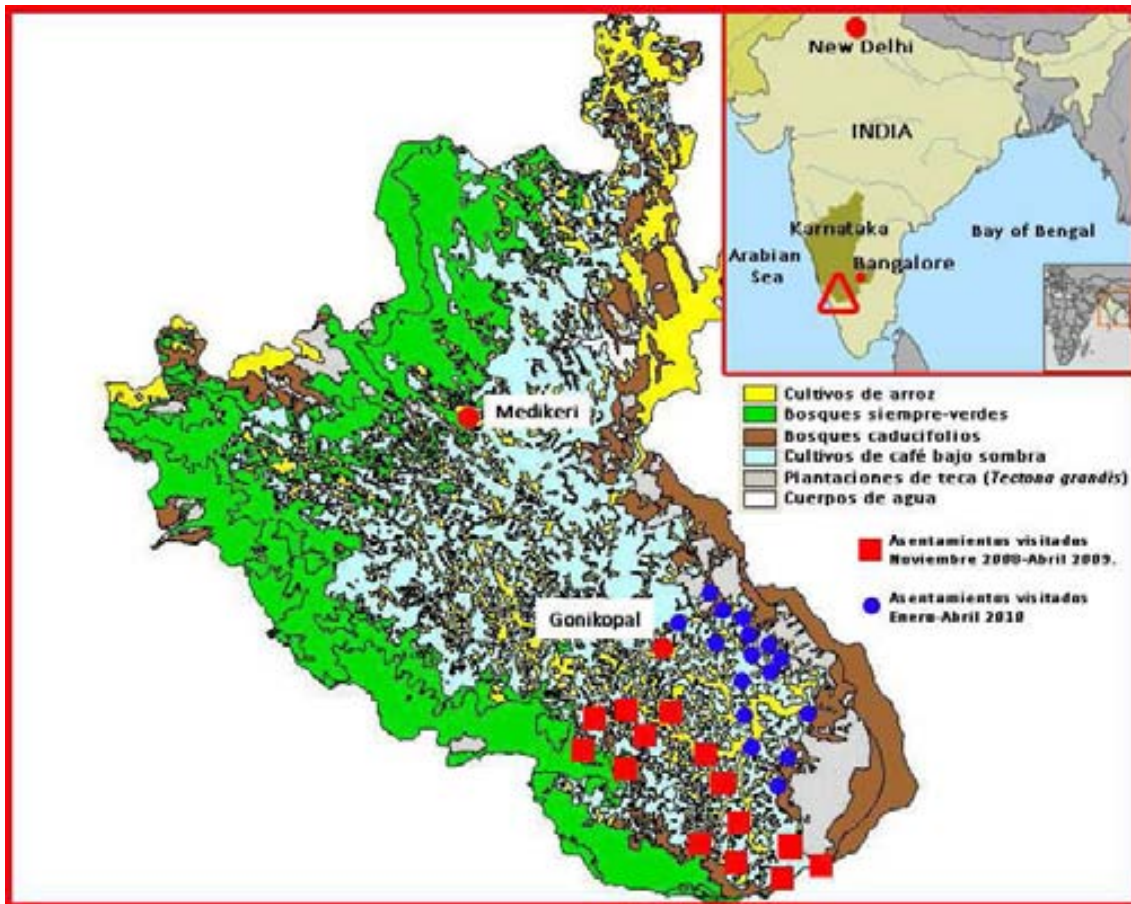


Figura b. Asentamientos visitados durante la investigación. La figura muestra la ubicación de los asentamientos visitados entre Noviembre 2008 – Abril 2009, y entre Enero 2010-Abril 2010.

capital (i.e. natural y económico), y iii) un conjunto de atributos sociales y culturales. Dedicué 4 meses para esta fase, desde Enero a Abril 2010. Con análisis estadísticos multivariados estimé las asociaciones entre variables de bienestar y los capitales, controlando por variables sociales y culturales. Los resultados de estos análisis cuantitativos son presentados en el tercer capítulo de la Tesis.

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## **Chapter 1:**

# **What defines Quality of Life? The gap between public policies and locally defined indicators among residents of Kodagu, Karnataka (India).<sup>‡</sup>**

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**Abstract**

Improving Quality of Life (QoL) is one of the main goals of many public policies. A useful tool to measure QoL needs to get a good balance between indicators guided by theories (top-down approach) and indicators defined by local people (bottom-up approach). However, QoL measurement tools often neglect to include elements that define the standard of living at local level. In this paper, we analyse the correspondence between Human Development Index, as an indicator adopted by governments to assess QoL, and the elements defined by local people as important in their QoL, called here local means. Using a free-listing technique, we collected information from 114 individuals from Kodagu, Karnataka (India), to capture local means defining QoL. We then compared local means with the indicators used by Human Development Report (HDR) of Karnataka, the main measurement tool of QoL in Kodagu. The list of local means included access to basic facilities and many issues related to agriculture and natural resources management as elements locally defining QoL. We also found that HDR does not capture the means defined by people as indicators of QoL. Our findings suggest an important gap between current QoL's indicators considered by public policies and the means of QoL defined by people. Our study provides insights for a set of plausible local indicators useful to achieve a balance between top-down and bottom-up approaches for the local public policies.

**Keywords:** Quality of life, human well-being, local means, Human Development Index, Kodagu, India.

## Introduction

The measurement and improvement of people's Quality of Life (QoL)<sup>4</sup> is considered one of the main challenges for governments, human development agencies, and researchers (Alkire 2002; Dodds 1997; Hagerty et al. 2001; Max-Neef et al. 1993; Rahman et al. 2011; Rawls 1999). Several approaches have been employed to measure QoL, but perhaps the most important and generalized is the approach based on indicators (Somarriba and Pena 2009). Indicators mediate between conceptualization and measurement and, therefore, contribute both to the accumulation of knowledge and to the development of policies aiming at the improvement of QoL (Dluhy and Swatz 2006; Frønes 2007; Hagerty et al. 2001). Indicators have a clear practical purpose to aid public policy (Hagerty et al. 2001). Nevertheless, spite of their importance, the advantages and liabilities of indicators still remain problematic (Frønes 2007; Hagerty et al 2001), particularly in terms of how to get a suitable set of indicators to obtain a successful tool on the assessment of QoL.

Authors have highlighted that the strength or weaknesses of a set of indicators could be based on, at least, three main factors. First, its coverage of the different dimensions defined by any of the models of QoL proposed in the literature (Hagerty et al 2001; see Alkire 2002 for the QoL's models). Set of indicators that partially cover those dimensions are weaker than more comprehensive set of indicators. Second, its universality. Since attributes that define the several dimensions of QoL change across cultures and historical periods (Costanza et al. 2007; Frønes 2007; Hagerty et al. 2001; Max-Neef et al. 1993; Swain and Hollar 2003), many indicators might not be applicable for all societies. For instance, indicators based on economic attributes of individuals have been widely used in empirical analysis to construct indices of QoL (Hagerty et al. 2001, Rahman et al. 2011), but they are undoubtedly unable to capture levels of QoL among societies disconnected from market economies (Masferrer-Dodas et al. 2011). In those cases, even formal education could be an inappropriate indicator of QoL. Third, since the conceptions of QoL change across levels of organization (i.e from the community to the region or country) (Frønes 2007; Malkina-Pykh and Pykh 2008; Rawls 1999; Swain and Hollar 2003), the reliability, validity, and sensitivity of the set of indicators depend largely on whether they are applied at the same scale at which they were conceived (Frønes 2007; Hagerty et al. 2001). Often, indicators conceived at country level do not work at lower levels, such as in the community.

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<sup>4</sup> Here we focus on the objective measure of Quality of Life (QoL) which is also referred to as objective well-being, objective welfare, and other near-synonyms. Without entry in their plausible differences, in this paper we use QoL as a synonym of all of them.



Over the last decade, several authors have stressed the importance of the involvement of community members and their views in QoL indicator research (Malkina-Pykh and Pykh 2008; McMhom 2002; Swain and Hollar 2003). One of the major theoretical concepts underlying the QoL indicator research is based on the premise that the definition and evaluation of QoL are conditioned by social, economic, and environmental attributes of the community (Sirgy 2011). McMahan (2002) describes that the development of QoL indicators for Bristol (United Kingdom) started as a local authority led top-down initiative, but improved by ideas and views of local people based on a bottom-up approach. Hence, the challenge for a good tool to operationalise QoL is to achieve a balanced match between indicators and elements defined by local people as satisfier of QoL. A good match between indicators and locally defined elements of QoL strengthens both the sensibility and ability of the QoL-related public policies to predict future outcomes (Hagerty et al. 2001). In particular, a balance between both approaches allows create an environment in which people can develop their full potential and lead productive, creative lives in accordance with their needs and interests, such as United Nations Development Programme (UNDP) has defined human development. Nowadays, UNDP's definition of human development is accepted worldwide and its Human Development Index (HDI) one of the tools most widely used by policy makers around the world.

Based on these ideas, this paper analyses the correspondence between a given measurement tool to assess QoL, particularly the Human Development Index (HDI), and the local concept of QoL. Our objectives are to i) describe the set of elements defined by local people as the most important to fulfil their QoL, called here local means, and ii) assess whether the HDI adopted by a given government as a QoL indicator matches with the means listed by local people. In order to address these objectives, we draw on empirical data from a case study of Kodagu district (State of Karnataka, India). We use a unique body of data collected directly from a set of individuals and compare it to current human development report used by local government in Kodagu (Government of Karnataka 2006). We hope that this reflection on the QoL's indicators will result in more opportunities for communities to become involved in the process of evaluation and improvement of QoL. This study highlights a gap in the practice and research of indicators and indices of QoL and enables the integration of the social and scientific political agendas (Costanza et al. 2007; DeLugan et al. 2011; Frønes 2007; Hagerty et al 2001; McMhom 2002; Rahman et al. 2011; Swain & Hollar 2003).

## **The study case**

### **Environmental and socioeconomic context**

Kodagu –also known as Coorg- is located in the south of Karnataka State, India. Its landscape is characterized by large expanses of shade-grown coffee plantations (60% of the total land surface) flanked by evergreen and deciduous forests (Bhagwat et al. 2005). Kodagu is part of the “Western Ghats”, one of the highest priority sites for biodiversity conservation in India, and hence the local government faces the challenge of balancing conservation of the local ecosystems and economic development (García et al. 2010). The main economic activity of Kodagu is the cultivation of coffee. Almost all the inhabitants of Kodagu are linked to the coffee business in some way, as owners of plantations, workers, or traders. Other commercial crops in Kodagu are ginger, cardamom, pepper, and rice.

India classifies its citizens according to their caste, tribe or community of origin, with a few overarching categories encompassing several such classes. Three main categories of interest for our study, with dissimilar cultural backgrounds and origins coexist in Kodagu: Scheduled Castes (SC), represented mainly by Panikas and Parivaras; Adivasi or Scheduled Tribes (ST), essentially Jenu-Kurubas, Betta-Kurubas, Soligas, and Yeravas; and the Other Backward Castes (OBC) mainly represented by Gowdas and Kodavas. The 2001 census recorded a population of 548,561 habitants in the district of Kodagu, where 12.4% were SC and 8.4% were ST (Government of Karnataka 2006).

According to this social differentiation, generally speaking, three kinds of settlements can be found in Kodagu. Towns are settlements with gathered houses and the presence of basic services, such as a school, market, public transport, health infrastructure, police station, and post-office. Villages have scattered houses with only some services (usually a primary school, small shop, and post-office). Lastly, adivasi colonies are settlements established by the government for low caste people. Colonies generally lack basic services. Some people in colonies still maintain their culture, and traditions, especially those who are settled far from urban areas inside the forest, in remote and inaccessible terrain devoid of modern amenities (Kshirsagar & Singh 2001, Demps et al. in press). Others are immersed in the mainstream system albeit generally occupying marginal positions, selling their workforce to the Karnataka Forest Department or to the coffee plantations.

### **Quality of life in Kodagu**

The main official instrument to measure the QoL in Kodagu is the Human Development Report (HDR) of Karnataka State. Although there are other antecedents reporting some QoL indicators

(e.g. Deshpande 2005), HDR is the main guide for the public policies on QoL in all Karnataka, as in other Indian states. As the main instrument of measurement and improvement of QoL, HDR could be understood as the approach to conceptualize QoL by local authorities. The report uses the Human Development Index framework (Government of Karnataka 2006) and captures several of its indicators. HDR emphasizes that Karnataka State has done an enormous effort to ensure the provision of optimal outlays on human development and the efficiency in spending in order to achieve the eight Millennium Development Goals proposed by United Nations (Government of Karnataka 2006). The report points out that government spending on social services (i.e. education, healthcare, nutrition, sanitation, and housing) can become a critical input for the fulfilment of personal incomes and basic human needs among poor people. Last, an important issue adopted by HDR has been the assessment of the levels of achievements in human development of the most disadvantaged and vulnerable sub-populations in Indian society, such as individuals belong to Schedule Tribes and Castes. The last HDR was published in 2005.

The Government of Karnataka is engaged in poverty reduction in Kodagu through the provision of social services and infrastructure. All these programs will have an impact on the QoL of the inhabitants. Currently, Kodagu ranks fourth out of the 27 districts of Karnataka in the ranking of Human Development Index report of 2005 (Government of Karnataka 2006). Kodagu has one of the highest indexes on literacy (78% of the total population), child immunization (96% of children between 12-23 months), school attendance rate (91% of children), and education infrastructure (mainly primary schools) (Government of Karnataka 2006). Kodagu also is one of the wealthiest districts of Karnataka. Only 4.9% of the population was living below the poverty threshold in the period from 1999 to 2001 (Government of Karnataka 2006).

However, HDR recognizes that much remains to be done. For instance, the infant mortality rate is still high (62 deaths / 1000 live births, at 2001) and the percentage of households with access to safe drinking water, electricity, and toilets is still low (40%). Furthermore, within Kodagu there are important differences between settlements. Thus, the percentage of households with access to safe drinking water, electricity and toilets decreases from 70% in urban areas to 36% in rural areas. Furthermore, severe gender and class inequalities on literacy, education and employment remain, and rural-urban disparities are also worrying. Educational levels are also higher in urban areas (90%) than in rural ones (76%).

There are several programs relevant to the QoL of the local inhabitants. The Social Welfare and Tribal Welfare Offices are concerned with social and household infrastructure, as well as with

educational and financial uplift of their respective target populations (Officer of Social Welfare Office at Kodagu, pers. com). Government has also developed programs to increase the level of formal education, environmental understanding, and sanitation. Government run Cooperative societies, called Large-scale Adivasi Multi-Purpose Societies (LAMPS), promote tribal development integration and economic solvency by supporting the commercialization of forest products (Bawa et al. 2007). People also receive subsidies for food and others basic needs through the Public Distribution System. Apart from governmental programs and institutions, there also are QoL-related programs carried out by local groups and Non-Governmental Organizations (NGOs).

## **Methodology**

### **Sampling and data collection**

We collected data over a six-month period (November 2008 to April 2009), with assistance in translation from Kannada (local language) to English. Our strategy of data collection included (a) interviews with key informants; (b) free-listings; and (c) a survey on socioeconomic attributes of informants.

#### **(a) Interviews with key informants: Background information**

During the first three months of fieldwork, we conducted a set of formal and informal interviews with key informants from Kodagu in order to capture background information about individuals and their life, as well as information on the different programs to improve QoL in Kodagu. Our key informants included a Tribal Welfare officer, president and members of local municipalities, adivasi leaders, the presidents of LAMPS, members of local NGOs, teachers of primary schools, and leaders of adivasi colonies. We also conducted informal interviews with individuals from several settlements outside the sample area. The interviews were designed to capture information on QoL-related policies, institutions, social organization, economic programs, education, standard of living, and ethnoecological relations.

#### **(b) Free-listing technique: List of Local Means**

The Free-listing technique does not require random sampling of individuals, but it does require that the full range of cultural issues impacting the cultural domain be sampled (Handwerker and Wozniak 1997). Since several cultural and socioeconomic attributes change across types of settlements (towns, villages, and adivasi colonies), we stratified our sample by selecting individuals living in different settlement types (Bernard 2005). In each settlement type, we

randomly recruited individuals until we reached saturation in answers to free-listings. The total sample for free-listing included 114 respondents, distributed in three towns (n=41 individuals), four villages (n=39), and seven adivasi colonies (n=34).

We adopt the term "local means" to refer to elements considered by people as important for their life. This definition includes those elements sprang up locally and those imported from other regions or upper levels of organization. We adopted the cultural consensus theory as the framework to design our methodology to capture the list of local means. Our methodological strategy recognizes that the community shares a common set of values, represented as a consensus view of community members regarding to QoL's concept. Specifically, we used the free-listing technique, a tool that consists of asking respondents to list elements in a given cultural domain (Puri 2011). The analysis of free-listing allows to capture the agreement among people in a particular domain of knowledge, in this case, QoL. Furthermore, free-listing not only captures a range of elements in a cultural domain, but also their relative saliency within the sample of individuals. Specifically, we asked respondents: *"Think about the important things in your life. Can you list all the important things you can think of?"* We prompted respondents to list as many elements as they could conceive. We then asked respondents to explain why they considered each element important. Listed elements were recorded following the same order in which the informant gave the answers.

Since the same basic element could be referred to by different names, we used the explanation given for each element to generate a final list of local means. For instance, people listed "food", "fruits", and "vegetables", which we classified as the local mean "food". People also listed "house" and "shelter", which we classified as "shelter". This correspondence between elements and means was done for each list. Since there is not necessarily a one-to-one correspondence, a given element could represent more than one means at the same time. To reduce interpretation bias, two independent coders worked to get the final lists of local means. When the two coders disagreed in the classification, we asked an additional independent coder to break the tie.

### **(c) Survey on Socioeconomic attributes**

After free-listing, we asked the respondents to provide some socio-demographic information, including gender, maximum school grade completed, number of spoken languages, cultivated land (in acres), total annual household income (in Rupees, 62 INR  $\approx$  1 € at February 2009), religion and caste in the case of Hindus (Scheduled tribes, Scheduled Castes, or Other

Backward Castes), and type of settlement in which they reside (town, village, or adivasi colony). All the variables were self-reported by informants.

## **Data analysis**

### **(a) Saliency of local means**

We calculated the saliency index of each local mean as an indicator of its overall importance. We used the formula  $S_{ji} = (n_i - r_{ji} + 1) / n_i$ , where  $r_{ji}$  refers to the ranking of the mean  $j$  in the list  $i$  and  $n_i$  to the number of means in the list  $i$ . Hence, the overall saliency of local mean  $j$  corresponds to its average saliency across respondents. We maintained the ranking of each listed element for the underlying local mean. In case a local mean was inferred from two or more elements, its rank was established as the average of the elements' ranks. The saliency index ranges from 0 to 1, with a local mean with a saliency close to 1 being the most frequently and immediately listed. The saliency index recognizes that respondents tend to list the most culturally important elements first and more frequently (Puri 2011).

### **(b) Correspondence between QoL indicators and local means**

In order to analyse the correspondence between indicators used by HRD-2005 and local means listed by people, we compared the similarities of the underlying concept behind each indicator or local mean. The underlying concept of indicators used by HDR-2005 was captured through the description offered by HDR (Government of Karnataka 2006). The underlying concept of each mean was captured through the different explanations given by individuals during interviews. The procedure allowed classifying indicators and local means into groups related to different components of QoL to facilitate comparison. For instance, health-related indicators and means were classified into a same group, so there were economic-related indicators and means.

To avoid confusion in the terms used in the following sections, we use the term "indicator" to refer to criteria used by the HDR-2005, "local mean" to refer to criteria listed by local people in the free-listings, and "item" to refer both indicators and means.

## **Results**

### **Sample description**

The 114 Individuals in our sample were, on average, 38 years old, and 54% of them were women. The sample was composed of 105 Hindu and nine non-Hindu individuals. Among the

Hindus, 24 individuals belonged to ST, 18 to SC, and 63 to OBC. The individuals of the sample reportedly cultivated an average of 3.9 (min=0, max=40) acres of land, mainly with coffee plantations. In terms of formal education, 12 individuals reportedly had never attended school, whereas 33 and 55 individuals said they have attended through first or second grade. Fourteen individuals reported having levels of education higher than second grade. 87% of all individuals were able to read the local language of Kannada. On average, people spoke four languages, the most commonly spoken being Kannada, Kodava, Kuruba, and English. In economic terms, households earned an average of 96406 (SD=196270) INR annually, however, the sample showed a large variability in the annual income, including households with no income and those who earned 1.2 million Indian rupees per year.

### List of local means

Respondents listed elements corresponding to 40 local means important to their well-being. Table 1.1 shows the 25 most salient local means mentioned by informants, indicating the number of individuals that listed each local mean and its saliency score. Only two local means were referenced by more than 50% of the people; three local means were listed by between 25% and 50% of the individuals of the sample, and the rest were mentioned by less than 25% of the sample.

The five most salient local means, i.e. those listed by at least 25% of the sample, were *water for domestic use* (n=64, S=0.47), *food* (n=60, S=0.39), *shelter* (n=55, S=0.29), *healthy environment* (n=41, S=0.24), and *agricultural products* (n=34, S=0.22). Table 1.1 also provides some examples of the specific elements mentioned by people that were classified in each of the local means listed. For instance, informants listed “water facility” in answer to our question about *important things in life*, which was explained as the need to fulfil all the basic water requirements of the household. Then, we coded this element as the local mean *water for domestic use*. The mean of *food* included those elements named by people to meet nutritional requirements, such as fruits, vegetables, and general food stuffs. *Shelter* comprised the basic infrastructure of the house. Elements from nature mentioned as being important to human well-being were denoted as *healthy environment*. For example, people referred to clean air, good water, forest, and good environment, all elements that we code in the same category. Finally, the mean of *agricultural products* grouped those elements described by people as having a role in the household subsistence and economy. People usually referred to coffee, pepper, ginger, rice, and cardamom, which are the main crops in Kodagu.

Table 1.1. Local means listed by Kodagu informants (n=114) as important elements to fulfill their Quality of Life (Kodagu, Karnataka, 2009) ranked by saliency.

Local means	Examples of answers	N (%)	Saliency
Water for domestic use	Water facilities	64 (56.1)	0.473
Food	Food, fruits, vegetables, rice, milk	60 (52.6)	0.397
Shelter	Shelter, house	55 (48.2)	0.283
Healthy environment	Clean air, good water, forest, good environment	41 (36.0)	0.247
Agricultural product	Coffee, pepper, ginger, rice, cardamom	34 (29.8)	0.224
Electricity energy	Electricity facilities	28 (24.6)	0.132
Income	Money, earnings	23 (20.2)	0.128
Work	Work, jobs, business	27 (23.7)	0.123
Clothing	Cloths	20 (17.5)	0.110
Transport	Transport facilities, public transport, roads	22 (19.3)	0.102
Cooking energy	Firewood, cooking gas	16 (14.0)	0.086
Domestic animals	Mutton, cow, hens, dog, pig	12 (10.5)	0.078
Saving	Money for future	11 (9.6)	0.077
Property	Property, own land, place to live, land	12 (10.5)	0.074
Formal education	Education, children education, schools	16 (14.0)	0.066
Household assets	Furniture, kitchen utensils	12 (10.5)	0.045
Irrigation water	Water for agriculture	4 (3.5)	0.031
Health	Health, hospitals, medicines	8 (7.0)	0.031
Employee	Workers	6 (5.3)	0.030
Household supply	Ration facilities	6 (5.3)	0.027
Sanitary infrastructure	Toilet facilities, public toilet	5 (4.4)	0.027
Communication	Communication, mobile, telephone facilities	4 (3.5)	0.014
Worship	Ceremonies, puja	2 (1.8)	0.011
Rights and legal system	Identity card, legal documents	2 (1.8)	0.010
Market access	Market access, shops	4 (3.5)	0.010
Friendship	Friends, neighbours	3 (2.6)	0.009
Fertilization	Manure, fertilizers	2 (1.8)	0.008
Believes	Believes	2 (1.8)	0.007
Protection of cultivation	Protection from wild animals	2 (1.8)	0.005
Family	Family members	2 (1.8)	0.005

Note: N (%) column shows the frequency of each mean in the sample. Saliency column shows the average score among individuals of the Saliency index for each mean. The index is calculated by  $S_{ji}=(n_i - r_{ji} + 1)/n_i$ , where  $r_j$  refers to the ranking of the mean  $j$  in the list  $i$  and  $n_i$  to the number of means in the list  $i$ .

### Indicators used by HDR-2005 vs local means

Table 1.2 shows the comparison between indicators of QoL used by the HDR-2005 in Kodagu and the list of means described by local people.

Similarities: We found that items related to health, nutrition, formal education, economy, and household security were listed both by HDR-2005 and by local people. For instance, the HDR-



2005 assesses different items related to health, such as public expenditure, health infrastructure, immunization, and others. Similarly, local people referred to health as an important aspect for their well-being arguing that they require better infrastructure, more medicines, and control of illnesses. Items related to nutrition were also mentioned both by the HDR-2005 and by people included in our study. Some informants explicitly referred to food as *“a source of nutrients”*. Items dealing with education also are found both in the HDR-2005’s and free listing results. The HDR-2005 evaluates five items related to education, three of which correspond to local means that also appeared during free listings. Many individuals also argued that education *“leads the life and the future of people, mainly for children”*.

Indicators specified by the HDR-2005 and local means by informants in this study also coincided in elements related to economy. For example, income and wages appear in both lists. In this study, many informants referred to income and earnings as important *“to have the opportunity to get and purchase food and things for the households”* as well as *“to provide educational opportunities to children”*. Some individuals also referred to work as an important element *“to get income and lead a good life”*. Other individuals mentioned employees as important *“to maintain the labor productivity of their agriculture and business”*, which represents agreement between the two studies in terms of considering labor production as a factor in the assessment of QoL. Some other similarities between the HDR-2005 and responses for this study related to household security, in particular the attributes related to house tenancy, access to and reliability of drinking water, and infrastructure of sanitation.

Dissimilarities: But there were also important differences between both lists. Several items not considered by the HDR-2005 were described by informants as important for their life. For instance, we found that the HDR-2005 did not consider market access in its statistics, whereas informants in our study described it as important for their life. According to our informants, market access allows *“the commercialization of agricultural products”* and *“the purchase of essential things for the household”*. Our informants also referred to economic security, stating that savings and property are important for their life, but none of those items have been included in the HDR yet. For people, saving money allows them *“to have the opportunity to buy things for the household in the short and long term”*. Similarly, according to our informants property is important because it allows them *“to have a space to live and bring up our children”* and *“to set our business”*.

We note that no indicator related to social and familiar relationships was included in the HDR-2005, whereas people highlighted that family and friendship are important for them. Similarly,

Table 1.2. Comparison between indicators of QoL used by Human Development Report of Karnataka (HDR-2005) and means defined by local people as important to fulfil their QoL.

Components of QoL	HDR-2005	Local means
Health	-	Health
	Public expenditure on healthcare	Health
	Government health infrastructure	Health
	Infant mortality rate	-
	Child immunization	-
	Maternal health	-
	Life expectancy	-
	Morbidity	-
	HIV/AIDS	-
	Nutrition	Intake of food
body mass index		-
Birth weight		-
Education	Access and enrolment to education	Formal education
	Literacy	Formal education
	Education outcome	-
	Teacher availability	-
	Education infrastructure	Formal education
	Dropout rates in primary schools	-
Gender development	Women's autonomy	-
	Women's work participation rate	-
	Violence against women	-
	Gender participation	-
	Gender empowerment measure	-
Economy	Income distribution and poverty	Income
	Real wages	Income
	Labor productivity	Employee and work
	Work participation rate	Work
	-	Market Access
	Child poverty	-
	Child labor	-
Economic security	-	Saving
	-	Property
Social and Familiar relationships	-	Family
	-	Friendship
Household security	Housing	Shelter
	Drinking water	Water for domestic use
	Sustainability of water supply	Water for domestic use

Table 1.2. Comparison between indicators of QoL used by Human Development Report of Karnataka (HDR-2005) and means defined by local people as important to fulfil their QoL.

Components of QoL	HDR-2005	Local means
	Sanitation	Sanitary infrastructure
	-	Electricity energy
	-	clothing
	-	Cooking energy
	-	Domestic animals
	-	Household assets
	-	Household supply
Environment	-	Healthy environment
Agriculture	-	Agricultural product
	-	Fertilization
	-	Protection of cultivation
	-	Irrigation water
Communication and transport	-	Transport
	-	Communication
Spirituality	-	Worship
	-	Believes
Governance	-	Rights and Legal System

there are several items among those related to household security that have not been considered by the HDR-2005. These items are electricity, clothing, cooking fuel, domestic animals, household assets and household supply. People usually described those means as important to meet the basic needs of members of their households. Healthy environment is another item discordant between the HDR-2005's and our findings. People recognize that relevant attributes and functions of the environment could affect positively their life.

Also, people listed items related to agriculture and described them as important for nutritional requirements, local economy, and household security, and therefore as a relevant components of local people's life. In spite of that, the HDR-2005 has not included agriculture's items into its statistics. Last, we also noticed that items related to communication and transport, spirituality, and governance were listed by people, but none of these items have been considered in the statistic of HDR-2005.

Contrarily, several indicators listed on the HDR-2005 were not listed by any of the informants. For instance, no one listed means related to gender development and children's labour ,

indicators that seem to be important criteria to measure QoL for the government. Similarly, people referred to health as a general element without specify particular means as government takes into account (e.g. infant mortality, child immunization, maternal health, life expectancy, and morbidity). In education, the education outcome, teacher availability and dropout in primary schools, also are dissimilarities between people's lists and official statistic of HDR.

In sum, we found similarities and dissimilarities between lists of items related to QoL by the HDR-2005 and those listed by people. Similarities were found in health, nutrition, formal education, economy, and household security. The main dissimilarities between local means and indicators were found in items related to economic security, social and familiar relationships, environment, agriculture, communication and transport, spirituality, and governance. We also found that gender development, child labor, and some indicators of health and education, were included into the statistic of HDR-2005, but were not listed by any of the informants.

### **Discussion**

A good match between indicators of QoL and means considered important for local people would allow to estimate, assess, and assure QoL improvements at local level ( DeLugan et al. 2011; Frønes 2007; Hagerty et al. 2001; McMhom 2002). In this article, we evaluated that match taking Kodagu as a study case. We focused the discussion of our results on three main issues: i) local means defined by people, ii) correspondence between indicators and local means, and iii) implications for Kodagu.

### **Local means**

Local means listed by people provide a local characterization of the concept of QoL. The set of local means listed reflects two local realities. First, the lack or bad conditions of basic facilities among many households and communities explains the frequent recall of local means related to basic facilities (e.g. water for domestic uses, shelter, and sanitary infrastructure). We observed, and people also mentioned during interviews, that water tanks and electric infrastructure were either without service or totally destroyed in many communities. Also, many houses were in poor conditions, mainly among colonies close to forest, to provide a good living. Even the government recognizes that, although Kodagu is one of the Karnataka's districts with better infrastructure of basic facilities, there is still much work to improve the

situation (Government of Karnataka 2006). Researchers and human development agencies recognise that one of the priorities to improve the QoL should be focused on providing basic needs to people, including things such as sanitation, clean water, and adequate food (Dodds 1997), which also were the top listed means by people from Kodagu. Second, the list of means also reflects the dependence of people from agriculture and natural resources. At least, seven means directly related to agriculture and natural resources were listed, such as healthy environment, agricultural product, domestic animals, irrigation water, fertilization, and protection of crops from wild animals. This finding supports the debate about the key role of services and resources offered by ecosystems on the QoL of local communities as emphasized by the Millennium Ecosystem Assessment (MEA) (2003, 2005).

Another important finding of this work refers to the diversity and composition of the list of means. For example, people from Kodagu listed means related to health, social, economy, nutrition, environment, and religion. Furthermore, some means unrelated to economy had higher saliency indexes than those economy-related means, which suggests that people perceive the non-economic means having a key role in the fulfilment of their QoL. This finding dovetails with previous research suggesting that QoL is fulfilled by diverse elements and not only by economy-related elements as has been implied by economists (Masferrer-Dodas et al. 2011; Myers and Diener 1995).

### **Indicators of QoL vs Local means**

Our results show a mismatch between indicators used to assess QoL by local government and the means defined by local people from Kodagu. This finding suggests that the current indicators used by local governments to evaluate QoL in Kodagu neglect researcher's suggestion regarding the well-balanced dialogue between top-down and bottom-up approaches as a strategy to get meaningful indicators of QoL (McMahon 2002; Swain and Hollar 2003; DeLugan et al. 2011). The top-down approach allows authorities to develop QoL measures guided by well-established theories and that can encourage and strengthen partnerships with other agencies. The bottom-up approach is needed to allow community residents and community stakeholder groups to identify indicators that are important to them, and hence to have the opportunity to incorporate those indicators into the public policies (DeLugan et al. 2011; McMahon 2002; Sirgy 2011). In particular for Kodagu, our results suggest that HDR has mainly followed a top-down approach, adopting meaningful items as QoL indicators such as gender development and child labour. This framework can be improved by including means defined by local people, such as environmental issues or savings. In this sense,

the tuning of both approaches can create a healthy debate among citizens and the local authorities, fostering food governance (McMahon 2002). Indeed, local participation is not only necessary for a suitable assessment of QoL, but it is also a keystone issue in other disciplines, such as environmental management (García and Lescuyer 2008)

Another noteworthy finding relates to the diversity of indicators and means, and their coverage of the components of QoL. Without entering into the debate about the approaches on the components of QoL explored in detail by Alkire (2002), we point out that indicators of HDR and means listed by people complement each other in coverage the different components of QoL. While some means naturally come from people's responses (e.g. environmental issues), others do not emerge from local discourses but they come from international policies (e.g. gender development). In this sense, integrating both HDR's and local views of QoL allows to attend a larger range of components of QoL, dovetailing with the suggestions of the literature in the topic (Alkire 2002; Costanza et al 2007; Hagerty et al 2001).

We point out three components of QoL in which dissimilarities arose from our results: economic security, environment, and gender development. Public policies usually include several economic indicators such as income or GDP as part of their measurement of QoL, but they neglect the importance of what –according to our results- seems a major concern for local respondents: the status of the economy over the time in order to secure the household livelihood or saving. Since saving increases the opportunity to satisfy livelihood requirements in periods of lacks of resources, saving increases the self-dependence of households in long-term. Max-Neef et al. (1993, p. 93) have emphasized that self-dependence, that can be increased with savings, allows a more complete and harmonious satisfaction of the QoL. Similarly, our results also suggest that environmental elements should be added into the statistics as one of priorities to fulfil local QoL. People in Kodagu considered the environment as a basic element of their lives, arguing that their health depends on environment quality. Despite the fact that researchers have largely recognized that the integrity of the ecosystems, and the goods and services they provide are key for human QoL (Costanza et al 2007; MEA 2003; MEA 2005; Rahman et al. 2011), too few public policies have included environmental attributes in their statistics of QoL (Costanza et al. 2007). Last, there is a general consensus among policy makers and researchers on that gender development has become one of the most important indicators of well-being. Nevertheless, particularly for those societies where differences between genders are deeply-rooted in their culture, its use as an indicator of QoL

is a big challenge. It is a clear example of the dominance of top-down approaches in the framing QoL-related policies.

### **Implications for Kodagu**

Results from this study contribute to assess the suitability of current public policies to estimate QoL, and thus can be used to see which policies must be checked and improved. From our work, we highlight two noteworthy findings.

Firstly, findings show that there is a gap between current indicators defined by the government and local means defined by people, suggesting that current policies must be redesigned to take into account a set of indicators of QoL meaningful locally. For example, people from Kodagu have recognized in the lists of means that their QoL strongly depends on nature. This finding encourages policy makers to consider environmental management policies as effective tools to improve the QoL of local people. Although currently environmental issues are partially considered into other sectorial policies (e.g. the Forest Right Act, Macura et al. 2011), their lack of inclusion into the measure of QoL proposed by the government suggests that the government holds an incomplete concept of QoL. We strongly suggest policy makers to include elements related to environment and economic security into the policies of QoL.

Secondly, this gap between indicators and local means also suggests that current policies lack a balance between top-down and bottom-up approaches in the selection of QoL indicators. Currently, HDR seems to be influenced mainly by top-down approaches, using indicators suggested by national or international policies. Nevertheless, since QoL always refers to people's development and if the main aim of public policy is to improve people's QoL, we also strongly suggest to include participation of local communities in the definition of the framework to assess their QoL and the evaluation of public policies related to it. Without false illusions about the powers of participation (see Garcia and Lescuyer, 2008), we stress that it is a keystone element in the success of public policies on QoL (Costanza et al. 2007; Hagerty et al. 2001; Malkina-Pykh and Pykh 2008; Rahman et al. 2011; Swain and Hollar 2003).

### **Conclusions**

A control on the indicators used by researchers and governmental agencies is requested in order to get policies that successfully improve QoL. We emphasize that a key issue is to incorporate into the policies those means defined by local people.

Public policies are heavily influenced by economic development thinking and they approach the QoL indicators guided by the interest of improving socioeconomic development based on economic indicators. As first conclusion, our study shows that people consider a diverse set of material and non-material elements as means to fulfil QoL. These means not only come from economy, but also from nature, social relationships, knowledge, and politics. As second conclusion, our study also shows an important gap between current QoL's indicators considered by policies and means of QoL defined by people. We argue that this study provides insights for a set of plausible local indicators that could be useful to achieve a well balance between top-down and bottom-up approaches for local public policies. We suggest that the local efforts on QoL should focus on getting a more complete list of means as well as maintain periodic and long term assessments on means and QoL levels. We also suggest that future research should focus on understanding how means related to QoL evolve in the societies and their suitable use as indicators of QoL. Future research also should strengthen the balance between top-down and bottom-up approaches in order to avoid gaps between QoL's public policies and local means.

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## **Chapter 2:**

# **Perception of ecosystem services and its determinants: a case of study among people from Western Ghats, India**

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**Abstract**

Ecosystems have been characterized as important ‘service providers’ for human societies. In this article, we aim to assess the local perception of ecosystem services and the socioeconomic determinants affecting individual perceptions. We use a unique body of cross-sectional data collected among individuals from the district of Kodagu (Karnataka), India. We carried out free-listings to capture what ecosystem services were locally perceived. Additionally, we conducted a structured survey to capture information on socioeconomic characteristics of 91 informants. We classified the ecosystem services into four categories of services defined by Millennium Ecosystem Assessment (i.e. provisioning, regulating, cultural, and supporting services) and calculated the number of services listed in each category. We found that ecosystems are locally perceived as a source of multiple goods and services that go beyond the production of food (for subsistence or for cash). Using multivariate regressions to estimate the associations between number of ecosystem services and socio-economic characteristics, we found that younger, wealthier, and more educated individuals perceive more ecosystem services than people without those characteristics. People from different cultural backgrounds also have different perceptions from local ecosystems services. Our study brings a list of ecosystem services that matter for local well-being and that would help focus policy decisions in the area. Since perceptions and uses of ecosystems differ across social groups, policies should take into account that any decision on ecosystem management would have dissimilar effects across individuals, an aspect often neglected by policy makers. Our findings also urge policy makers to take more bottom-up as opposed to top-down, generic, blueprint approaches to planning interventions.

**Key Words:** Ecosystem services, agroecosystems, socioeconomic attributes, Kodagu.

## Introduction

Ecosystems have been characterized as important 'service providers' for human societies. The conceptual bases of these ecosystem services and their linkages to human life have been proposed in the Millennium Ecosystem Assessment (MEA) (Carpenter et al., 2009; Daily and Matson, 2008; Millennium Ecosystem Assessment, 2003). Prior to, and contemporaneous with, the MEA framework, a series of theoretical approaches from the social sciences have been developed to understand human-environment relationships (see Dove and Carpenter 2007). Among the earliest of conceptual frameworks, Steward's *cultural ecology* approach (Steward, 1977), the *ethnoecology* of Conklin, Berlin and Ellen (Conklin, 1954; Berlin, 1992; Ellen, 2006), and the *ecological anthropology* of Bateson, Rappaport, Vayda (Rappaport, 1968; Vayda and Rappaport, 1968; Orlove, 1980), stand out, and are all still relevant today. Contemporary approaches that grew out of, or in response to, these include *human evolutionary ecology* (e.g., Smith and Winterhalder, 1992), the *social-ecological systems* approach (SES) of the Resilience Alliance (Berkes et al., 2003), *historical ecology* (Balée, 2006), *political ecology* (Blakie and Brookfield, 1987), the *new ecology* (Scoones, 1999; Beirsack, 1999), *symbolic ecology* (Descola, 1995), *phenomenological approaches* (Ingold, 2000), and *biocultural diversity studies* (Maffi, 2005). Driving the evolution of this research over the last 60 years or so has been the desire, indeed the necessity, of capturing the complexity, variability and inherent embeddedness of humans in ecosystems more fully into conceptions of human-environment relationships (See Dove and Carpenter, 2007). In the contemporary view, human societies are embedded in complex, often multiple, ecosystems, co-evolved over long periods of interaction, and are thus intimately interrelated with ecosystem functions, sometimes benefiting from the services ecosystems provide, and at other times acting to manage and enhance limited functions to satisfy human needs, or to control hazards and risks to people. While there are differences among contemporary social scientists, often disciplinary in origin, concerning where to focus one's attention, or where the causal determinants of change may lie, most would agree that the central problematic is to avoid reproducing a dualistic conception of humans as separate from their biophysical environments. As Bateson (1979) argued, it's the 'organism-plus-environment' that is the proper unit of analysis.

Coming from natural science backgrounds, where time frames are often much longer and thus humans are seen as relatively new, and often as a disturbance factor in ecosystems, the developers of the MEA's framework are only just beginning to recognize that there are some limitations in the framework, such as double counting problems and some ambiguity in the

way the framework incorporates the human dimension and that considerable clarifications are needed (Chan et al., 2012; Hodgson et al., 2007; Wallace, 2007). Nevertheless, perhaps the most important contributions of the MEA are in clarifying the distinction between ecosystem functions and ecosystem services and widening the concept of services beyond that provided by biodiversity (provisioning), which in a policy context serves to re-emphasize and also broaden the *value* of nature for society (see Hodgson et al., 2007). Thus, the MEA framework has been adopted by scientists and policy-makers concerned with the management of ecosystems and their relationships with local people (Carpenter et al., 2009; Daily and Matson, 2008; Fisher et al., 2009), and has resulted in new approaches for research, conservation, and development (Daily and Matson, 2008). In particular, researchers and policy-makers agree on the relevance of human social and cultural characteristics (i.e. perceptions, knowledge, values, needs, practices and so on) in research on ecosystem services (Millennium Ecosystem Assessment, 2003; Pavlikakis and Tsihrintzis, 2003; Tuvendal and Elmqvist, 2011). Thus in this article, we build on the MEA framework a) to assess local perceptions of ecosystem services and then b) to explain variation in these perceptions in terms of demographic, social, and economic factors.

The way ecosystem services are perceived by different societies and the implications that different perceptions may have for environmental policy and governance has become a prominent topic in recent ecosystem services research (Pereira et al. 2005; Martín-López et al. 2007; Castro et al. 2011; Calvet-Mir et al. 2012; Martín-López et al. 2012). Two critical insights have been advanced by research in this direction. Firstly, research on ecosystem services should look at the range of services drawn specific to each society (Rodriguez et al., 2006). A given ecosystem has the potential to offer a wide range of services, a potential that is sometimes referred to as ecosystem functions (de Groot et al. 2002). However, which ecosystem functions are actually used, enjoyed or exploited as ecosystem services depend on social preferences and perceptions, and therefore the use of ecosystem services tend to differ across cultures and geographical regions (Costanza et al., 2007). For instance, studies among rural populations in Europe on ecosystem services' preference suggest that preferences vary from one country to another: Provisioning services, mainly the provision of food and fuel, are the most important services drawn on by rural societies from Portugal (Pereira et al., 2005), whereas regulating (Castro et al., 2011) or cultural services (Calvet-Mir et al., 2012) are the most valued ecosystem services in communities from Spain. Recent research also suggests that the perception of ecosystem services vary significantly between rural and urban population (Martín-López et al., 2012). Secondly, there is variability across individuals on preferences of

ecosystem services (Hein et al., 2006; Tuvendal and Elmqvist, 2011). This variability is often associated to the socioeconomic attributes and cultural backgrounds of the informants. For instance, the sex of the informant, and her/his level of schooling, environmental awareness, wealth, land tenure, or caste help explain differences on people's preferences on ecosystem services (Calvet-Mir et al., in press; Castro et al., 2011; Udayakumara et al., 2010). Therefore, given the variability of ecosystems services and of human societies, it is likely that local people's preferences on ecosystem services will be context specific rather than broadly applicable across all circumstances (Kontogianni et al., 2010).

Research on how ecosystem services valuation varies across individuals is relevant for the design of strategies to balance conservation efforts and local development (Balvanera et al., 2001; Egoh et al., 2007; Tuvendal and Elmqvist, 2011). This type of research is particularly relevant in areas where rich biodiversity and vulnerable societies coexist (Balvanera et al., 2001; Egoh et al., 2007; Millennium Ecosystem Assessment, 2003). This is the case for the Western Ghats in India. The Western Ghats have been defined as a world priority site for biological conservation because of its rich biodiversity and strong human disturbances (Myers et al., 2000). Local societies are heavily dependent on this rich biodiversity for their well-being. Increasing pressure on resources, such as agricultural land, water and forests, has resulted in a fragmented landscape, affecting the way local societies use resources (Bhagwat et al., 2005b; Garcia et al., 2009; Myers et al., 2000). Lands not-covered by tropical forest outside protected areas, such as agroecosystems, have become a valuable space to maintain the overall integrity of biodiversity (Bawa et al., 2007; Bhagwat et al., 2005a, b; Bhagwat et al., 2008; Garcia et al., 2009; Karanth and DeFries, 2010). Nevertheless, since agroecosystems are, by definition, human created and managed landscapes that provide livelihoods for local people, research agendas must include efforts to understand the complex relationships between local communities and their agroecosystems (Garcia et al., 2009).

Building on the ecosystem services approach, in this article we illustrate this type of research with a study of the human dimensions of services offered by agroecosystems in the Kodagu District of the Western Ghats, in Karnataka, India. Specifically, we assess local perception of ecosystem services offered by agroecosystems and identify the set of prominent ecosystem services perceived by local people. Since there is a large diversity of social groups with interests in the studied agroecosystems (Garcia et al., 2009), we then sought to capture and explain variation in the perceptions of a sample of these individuals across several important



social, cultural and economic variables. We use a unique body of cross-sectional data collected among individuals from the district of Kodagu (Karnataka), India.

### **The study case**

Kodagu is a rural district located on the eastern slope of the Western Ghats mountains range in the south of the State of Karnataka, India (11°56' - 12°52' N and 75°22' - 76°11' E). As in other parts of the Western Ghats, in Kodagu high levels of biodiversity converge with strong processes of disturbance generated by anthropic activities (Bhagwat et al., 2005a, b). The original evergreen and deciduous forests of Kodagu have been replaced by agricultural lands and, currently, the remaining forests cover only a 30% of the total surface of Kodagu (Fig. 2.1). A large part of Kodagu is under cultivation. Approximately 60% of the surface of Kodagu is covered by shade-grown coffee based agroforestry systems and about 8% by crop fields of rice, ginger, and cardamom (Bhagwat et al., 2005a, b). The main economic activity of Kodagu is agriculture, with coffee production as the main business. Coffee production involves all local inhabitants of the district in some way, either as plantations owners, to pickers or traders. In fact, individuals recognize that their well-being largely depends on many elements associated to local agriculture in general and coffee production in particular (Chapter 1). Most of the remaining forest in the area has some type of protected status, and therefore, the extraction, consumption, and commercialization of natural resources are strongly regulated by the State. Only people with a licence given by governmental cooperative societies, called Large-scale Adivasi Multi-Purpose Societies (LAMPS), can legally collect and commercialize natural products (Macura et al., 2011).

Kodagu's inhabitants belong to a wide range of socioeconomic conditions and cultural backgrounds. For instance, economic indicators, such as wealth, show large variation between farmers and non-farmers. Furthermore, within Kodagu there are important differences in the socioeconomic condition of people living in urban versus rural areas. Thus, the percentage of households with access to safe drinking water, electricity, and toilets varies from 70% in urban to 36% in rural areas (Government of Karnataka, 2006). The cultural backgrounds of Kodagu's population can be classified into three main categories: scheduled castes (SC), represented mainly by Panikas and Parivaras; adivasi or scheduled tribes (ST), essentially Jenu-Kurubas, Betta-Kurubas, Soligas, and Yeravas; and the other backward castes (OBC) mainly represented by Gowdas and Kodavas. The 2001 census recorded a population of 548,561 habitants in the district of Kodagu: 12.4% were SC and 8.4% were ST (Government of Karnataka, 2006). For

instance, whereas scheduled tribes were moved out from their original settlements inside the Kodagu's forest and relocated in adivasi colonies (Demps et al., 2012; Kshirsagar and Singh, 2001; Laval, 2008), SC came from other districts to work as farm-workers in Kodagu.

Three different types of settlements can be defined in our study zone. Most of the population is settled in towns located in the area under coffee plantation. Towns are composed of dense neighbourhoods of houses and basic services, including schools, markets, public transport, health infrastructure, police station, and a post-office. Villages are also located in the coffee area, but they are composed of scattered houses and few services, usually a primary school, small shop, and post-office. Lastly, adivasi colonies are settlements established by the government for ST and SC. Colonies generally lack basic services. This settlement pattern is important because it conditions how people interact with their environment. For instance, farmers from villages are basically dependant on their cultivated lands to sustain their livelihoods. Some people in colonies still maintain their culture and traditions, especially those who have settled far from towns inside the forest, in remote and inaccessible areas (Demps et al., 2012; Kshirsagar and Singh, 2001). However, other colony inhabitants have abandoned their traditional lifestyle and now work in coffee plantations, generally occupying marginal positions.

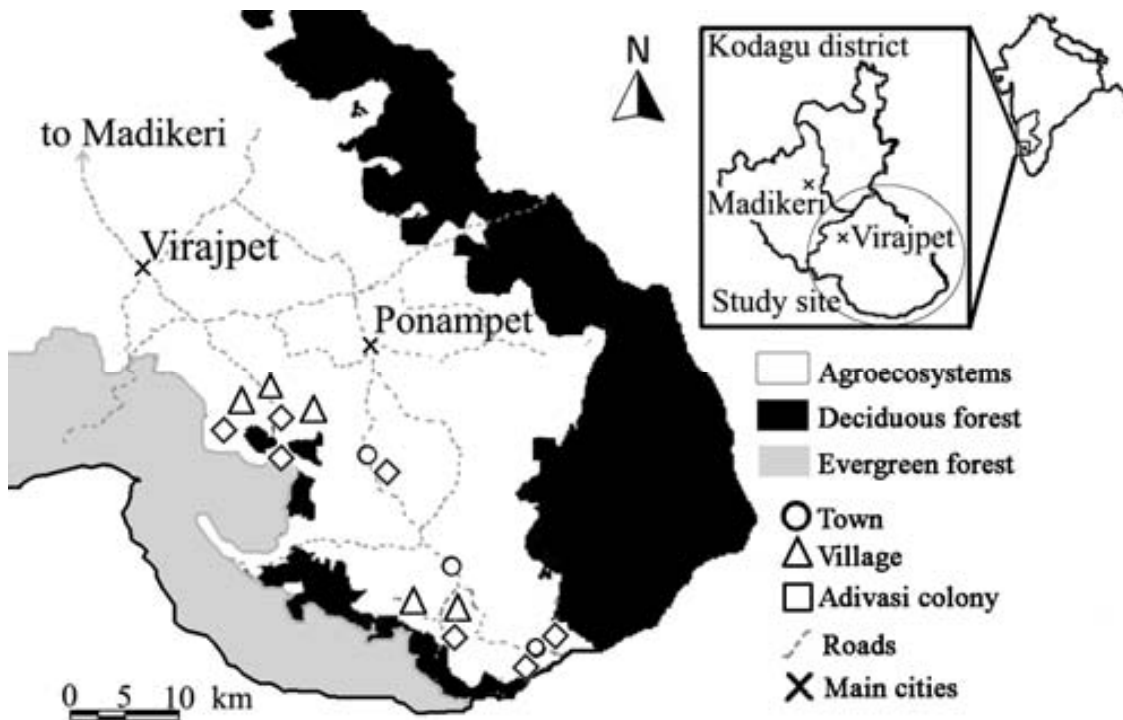


Figure 2.1. Study site. Towns, villages, and adivasi colonies visited in Kodagu District (November 2008-April 2009).

## Methodology

### Data collection

Data were collected between November 2008 and April 2009. Kodagu is divided in three political administrative areas that maintain the political, fiscal, and administrative power over a set of settlements. This research was carried out in the Virajpet area in the south of Kodagu. We collected data through i) informal interviews with key informants, ii) free-listings, and iii) a survey. Local translators fluent in Kannada and English supported data collection.

#### (a) Informal interviews:

To be able to contextualize the way in which people from Kodagu relate to their natural environment, we devoted the first three months of fieldwork to formal and informal interviews with key informants. We interviewed the president and members of local municipalities, tribal leaders at district level, presidents of LAMPS, members of local NGOs, teachers of primary schools, and leaders of adivasi colonies. Through those interviews, we mainly collected information about the most common natural resources used by local people, legal issues on natural resource use, differences on human-nature relationships within Kodagu society, and other related issues.

#### (b) Free-listing:

We used a structured interview technique known as freelisting to illuminate the full range of ecosystem services known to local people. Free-listing is a data collection tool that builds on the theory of cultural consensus (Romney and Weller 1986), which posits that shared knowledge of a cognitive domain is cultural knowledge, and high agreement among members of a group on the content and structure of a domain is evidence of a culture. Free-listing aims to elicit from individuals the items that compose a given cultural domain, the relative saliency (or meaningfulness) of items, and the level of agreement among respondents on the items listed (Puri, 2011). Freelists allowed us to test the assumption that a particular community shares a common set of values regarding nature (Handwerker and Wozniak, 1997), in particular those values relating to what we call “ecosystem services”, and then explore differences between the communities in Kodagu. Our sampling protocol included a stratification and then a random selection of individuals. We first stratified Virajpet’s population by settlement type (i.e. town, village, and adivasi colony), since our basic assumption is that settlement is a factor determining the relationship between people and ecosystems. We randomly selected a set of settlements for each type. In each settlement, we followed a protocol to achieve a random selection of households. In each household, we

interviewed an adult willing to participate in the study. For each settlement type, we recruited individuals until we reached saturation in answers to free-listings. In total, we interviewed 91 individuals distributed in three towns (29 individuals), five villages (33 individuals), and seven colonies (29 individuals) (Figure 1).

We recognized that that residents of Kodagu were unlikely to have a conceptual domain equivalent to our scientific category 'ecosystems services', so we had to design and test freelist questions that would capture the concept in their own terms. First, we asked individuals to list a set of natural resources used in the area. Specifically, we asked people "Think about the natural resources used by people in the area. Can you list the natural resources people use?" In the second question, aimed at capturing ecosystem services related to indirect and non-material values, we asked people to list reasons why locals need or benefit from ecosystems around them. We asked "Think about reasons why people from Kodagu need nature around them. Can you list reasons of why people need nature around?" Questions were tested among individuals from a different sample. We chose the questions described because during testing they were well understood by people, and responses captured a longer list and higher diversity of items than other questions. A similar question was successfully used by Reyes-García and collaborators (2011) to capture the services of water tanks in rural communities in India. For both questions, we probed individuals to list as many items as they could think of. We then asked individuals to explain the uses of each natural resource (for the first question) or why they considered each reason important (for the second). Natural resources and reasons were recorded in the same order in which individuals listed them.

**(c) Survey about socioeconomic attributes:**

In addition to the freelist exercise, we gathered information about socioeconomic attributes of informants through a survey. We first recorded the sex and the type of settlement in which the informant lived (town, village, or colony). We then asked individuals their age, level of schooling (none, primary, secondary, and superior), cultural background (i.e. religion and, in case of Hindus, also caste), and land ownership (coded as 1 if individual reported to own some land). Lastly, we assessed household wealth through three proxy variables: i) household annual income (in Rupees, 62 INR = 1€ at February 2009), ii) ownership of a set of manufactured (assessed as tenancy of a set of manufactured goods, i.e., motorcycle, water pump, gas cooker, house, and car); and iii) number of acres of land that the household had under cultivation.

**Analysis**

**(a) Saliency Index**

From responses to free-listings, we calculated i) the frequency of mention for each item and ii) the average rank (order of mention) for each item. We then estimated an index of Saliency ( $S$ ) of each item as a proxy of its cultural prominence (Borgatti, 1996; Puri, 2011). We used the formula  $S_{ji} = (n_i - r_{ji} + 1)/n_i$ , where  $r_{ji}$  refers to the ranking of the item  $j$  in the list  $i$  and  $n_i$  to the number of items in the list  $i$ . The overall saliency of item  $j$  corresponds to its average saliency across individuals. The saliency index ranges from 0 to 1, with an item with a saliency close to 1 being the most frequently and immediately listed. We analysed answers to the two free listings, i.e. natural resources and reasons why people need nature, independently.

Following Reyes-García and collaborators (2011), we created four categories based on the index of saliency: high saliency ( $S > 0.5$ ), medium saliency ( $0.1 < S < 0.5$ ), low saliency ( $0.01 < S < 0.1$ ), and marginal saliency ( $S < 0.01$ ). As emphasized by Reyes-García and collaborators (2011), the real indicator of importance of the items is the Saliency index and the categories are only used to facilitate the discussion.

#### **(b) Ecosystem services classification**

The ecosystem services approach groups the services into four broad categories –i.e. provisioning, regulating, cultural, and supporting services (Millennium Ecosystem Assessment, 2003)- and a set of subcategories for each category of service. We used the explanations people provided after free-listings to classify the items listed according to the typology of ecosystem services proposed by the MEA. We classified items into MEA categories rather than using the unclassified lists of items, to avoid double counting. For instance, fruits and vegetables were listed as two different items during the survey, but both were included under the ecosystem service type ‘food provision’. Since a given item could have different uses and values and thus represent different ecosystem services (see e.g. Chanet al. 2012), we classified each item in our lists according to the explanation provided by informants. For instance, pepper was listed as a food but it was also listed as a medicine to treat cough and cold. Consequently, we classified pepper in both the food and medicine subcategories on the provisioning services category. We also acknowledge that there is some overlap between the four categories of ecosystem services and our classification might suffer from this weakness. To reduce interpretation bias, two of the authors coded all the items in all the free listings independently. When the two coders disagreed in the classification, we asked an additional independent coder to break the tie.

#### **(c) Statistical analysis**

We ran multivariate regressions to estimate the association between the number of ecosystem services perceived by people (outcome variable) and their socioeconomic attributes (explanatory variables).

Outcome variables: Based on the number of ecosystem services listed by a respondent in their two free-listings, we calculated six outcome variables. First, we calculated the number of categories of ecosystem services that occurred in each person's lists. This variable ranged from 1 to 4 (provisioning, regulating, cultural, and supporting). Second, we took the total number of ecosystem services in a person's lists. Last, we calculated four individual variables with the total number of subcategories mentioned for categories of ecosystem services of provisioning, regulating, cultural, and supporting.

Explanatory variables: We used the socioeconomic attributes of the informants as explanatory variables in our models. To create a unique measure of wealth, we ran a Principal Component Analysis (PCA) with our three proxy variables: total annual household income, number of manufactured goods owned by the household, and number of acres of land under cultivation (Vyas and Kumaranayake, 2006). PCA suggests that three variables converged into one factor (Eigenvalue = 2.30) and a Cronbach's alpha analysis reported a high internal consistency among them (alpha=0.85).

Regression model and robustness analysis: We used Poisson regression models in our estimations. We used the Huber variance estimator to control for mild violation of the normality assumption (Cameron and Trivedi, 2009). We also clustered the models by type of settlements (i.e. town, village, and colony) to indicate that there is dependence within settlements type but independence in response among settlements. Last, to estimate the consistency of our results, we ran a robustness analysis by introducing a set of perturbations in our core models. We ran models i) with socioeconomic attributes intentionally dropped (e.g. land tenure), ii) using only either the female or the male sample of respondents, and iii) without cluster by settlements. To test the robustness of our results, we checked the consistency of the sign, magnitude, and statistical significance of our estimates across models.

## **Results**

### **Sample description**

Table 2.1 shows the descriptive statistic of socioeconomic attributes of informants and of other variables used in the regressions. In the sample, 39 (or 43%) individuals were male. The

average age of our respondents was 41.1 years (SD=16.2). Standard deviation and range values suggest a high variability in several socioeconomic attributes of the sample, such as wealth, occupation types, schooling, and land tenure. The sample was composed of individuals from different cultural background (i.e. religion and caste).

## **Saliency of items**

### **(a) Natural resources used**

Table 2.2 shows the list of natural resources used in the area by local people, grouped by saliency categories. Individuals listed a total of 85 different natural resources. On average, each person listed 6.7 different natural resources (SD=2.85). The shortest list had only one natural resource whereas the largest list included 15.

Coffee was the only natural resource that fell in the high saliency category. Coffee was listed by 70 individuals (or 77%) and, on average, it was listed in the 2.5<sup>th</sup> position in a lists (S=0.62). We found twelve natural resources in the medium saliency category. In general, natural resources in high and medium saliency categories were related to cash-crops (e.g. coffee, pepper, rice, and arecanut), and subsistence-oriented crops (coconut, vegetables, mango, orange and fruits in general). For example, pepper had the higher number of mentions in the medium saliency category (57 individuals) and saliency (S=0.38). Rice was the second natural resource, listed by 41 individuals and with a saliency score of 0.31. Firewood and water supply also appear in the medium saliency group.

We found that 72 of the 85 natural resources had a saliency score lower than 0.1. Among them, 37 natural resources fell in the low saliency category. Cardamom, trees in general, and ginger were the resources mentioned more often (Table 2.2). In this low saliency category we also found cash-crops (e.g. cardamom and ginger), and subsistence-food (e.g. honey, guava, jackfruit, papaya, milk, and so on). Other groups within this category were animals (e.g. wild and domestic animals), construction material (e.g. trees in general and bamboo), and biochemical products (e.g. soap nut). Last, thirty-five, or 41%, of all natural resources listed by people fell in marginal saliency category (data not shown). Natural resources in this category were basically mentioned by just one individual, and they included resources mainly related to food (e.g. gooseberry, salt, potato, beans, and onion) and material for construction (e.g. stones and sand).

Table 2.1. Descriptive statistic of individuals' attributes (n=91) from Kodagu (India, 2009).

Variable	Definition	Mean (Std. Dev.) or Frequency (and %)	Min-Max
Male	Sex of informant (male=1)	39 (43%)	
Age	Age of informant, in years.	41.1 (16.2)	16 – 90
Household Annual income	Household annual income reported by informant, in thousand of Indian Rupees (62 INR ≈ 1€, at February 2009).	197.9 (456.1)	1 – 3000
Ownership of manufactured	Number of manufactured goods (i.e. motorcycle, water pump, gas cooker, house, car) owned by household.	1.96 (1.7)	0 – 5
Acres of land	Total land cultivated by household, in acres.	7.19 (12.2)	0 – 60
Household wealth	Household wealth estimated as a function of household annual income, ownership of manufactured, and acres of land. Scores are standardized units of first component by PCA.	0.00 (1.52)	-1.2 – 7.2
Schooling	Level of schooling of individual (i.e. none, primary, secondary, and superior).	1.66 (1.01)	0 – 3
Land ownership	Land under the ownership of informant (yes=1).	43 (47%)	
Cultural background	Religion and castes self-reported by informants.		
Non-Hindus (nH)	Individuals self-described as non-Hindus, such as Muslims and Christians.	6 (7%)	
Scheduled tribes (ST)	Individuals belonging to Scheduled tribes, such as Betta-kurubas and Jenu-kurubas	22 (24%)	
Scheduled castes (SC)	Individuals belonging to Scheduled castes, such as Harijanas and Kannadigas.	12 (13%)	
Other backward castes (OBC)	Individuals belonging to Other backward castes, such as Kodavas, Gowdas, and Brahms.	51 (56%)	
Settlement	Settlement of residence of informant.		
	Town	29 (32%)	
	Village	33 (36%)	
	Adivasi colony	29 (32%)	



Table 2.2. Listed natural resources: results from free-listing (n=91) in Kodagu (India, 2009).

Items listed	Frequency	Saliency (S)
<b>High saliency (<math>S &gt; 0.5</math>; <math>n=1</math>)</b>		
Coffee	70	0.62
<b>Medium saliency (<math>S &lt; 0.5</math> and <math>S &gt; 0.1</math>; <math>n=12</math>)</b>		
Pepper	57	0.38
Rice	41	0.31
Coconut	31	0.16
Mango	24	0.14
Vegetables	21	0.14
Arecanut	23	0.13
Firewood	18	0.13
Water supply	15	0.13
Banana	26	0.12
Orange	23	0.12
Fruits in general	18	0.11
Sapota	14	0.10
<b>Low saliency (<math>S &lt; 0.1</math> and <math>S &gt; 0.01</math>; <math>n=37</math>)</b>		
Cardamom	16	0.08
Ginger	17	0.08
Tree in general	13	0.08
Honey	8	0.06
Soap nut	6	0.05
Guava	10	0.05
Bamboo	7	0.05
Plants in general	7	0.05
Jackfruit	10	0.04
Wild animal	5	0.04
Wheat	6	0.04
Air purification	4	0.03
Manure	6	0.03
Butter fruit	6	0.03
Tea	5	0.03
Papaya	5	0.02
Domestic animal	4	0.02
Milk	5	0.02
Root	3	0.02
Ragi	3	0.02
Lemon	4	0.02
Grapes	2	0.02
Oil	3	0.02
Apples	2	0.02
Medicinal plants	2	0.02
Fish	3	0.02
Cotton	3	0.02
Sun light	3	0.01
Tomato	3	0.01
Flowers	4	0.01
Food	3	0.01
Egg	2	0.01

Table 2.2. Listed natural resources: results from free-listing (n=91) in Kodagu (India, 2009).

Items listed	Frequency	Saliency (S)
Pineapple	2	0.01
Timber	3	0.01
Leaves	4	0.01
Grass	2	0.01
Tamarind	4	0.01

***Marginal saliency (S<0.01; n=35, data not shown)***

#### (b) Reasons why people felt they need nature

People listed a total of 35 reasons in answer to our question of why people need nature (Table 2.3). The lists had an average three different reasons (SD=1.72). Three individuals did not list any reason. Among the ones who listed at least one reason, the shortest list had only one reason and the largest list had nine different reasons.

Of the reasons listed, none fell in the high salience category. The category of medium saliency included six of the 35 reasons listed. The most salient reasons were related to regulating ecosystem services. For instance, “air purification” was mentioned by 44 people (48% of the sample) and, on average, listed in the second position (S=0.39). The second most salient reason was “water supply and maintenance” listed by 42 individuals (S=0.32). From the reasons in this category, three related to the maintenance of ecosystems elements and processes (e.g. air purification, water supply and maintenance, climate regulation), two related to provision of natural resources (e.g. food provision, water supply and maintenance), and two related to the survival of living beings (e.g. plant and human survival), or so-called supporting ecosystem services.

The low saliency category included 17 different reasons of why people felt they need ecosystems. Natural resources provision was listed by nine individuals (9.8% of the sample; S=0.09). Six reasons related to provision of natural resources (e.g. provision of natural resources in general, or provision of firewood, bamboo, money, leaves, and soap nut in particular), five reasons related to the maintenance of the ecosystem processes and components (e.g. maintenance of landscape, agriculture, quality of environment, soil, and natural processes), and five directly related to maintenance or support of human activities (e.g. agriculture support, firewood provision, health support, domestic animal survival and shelter support).

Table 2.3. Listed reasons why people need ecosystems or benefit from them: Results from free-listing (n=88)\* in Kodagu (India, 2009).

Items listed	Frequency	Saliency (S)
<b>Medium saliency (<math>S &lt; 0.5</math> and <math>S &gt; 0.1</math>; n=6)</b>		
Air purification	44	0.39
Water supply and maintenance	42	0.32
Plant survival	23	0.16
Food provision	19	0.15
For everything	14	0.13
Climate regulation	15	0.12
<b>Low saliency (<math>S &lt; 0.1</math> and <math>S &gt; 0.01</math>; n=17)</b>		
Natural resources provision in general	9	0.09
Wildlife protection	13	0.07
Landscape maintenance	11	0.07
Firewood provision	10	0.07
Agriculture support	8	0.07
Health support	7	0.06
Sun radiation	9	0.05
Quality of environment maintenance	7	0.05
Shelter support	6	0.05
Maintenance of all natural processes	5	0.02
Domestic animal survival	4	0.02
Cleanness	3	0.02
Soil formation	3	0.02
Bamboo provision	3	0.02
Leaves provision	3	0.01
Money provision	2	0.01
Soap nut provision	1	0.01
<b>Marginal saliency (<math>S &lt; 0.01</math>; n=12, data not shown)</b>		

\*Three individuals did not list any reason.

### Ecosystem services

On average, the items that people listed could be classified in 5.14 (SD=2.76) different ecosystem services. Among the four categories of services, individuals mentioned an average of 2.90 (SD=1.51) and 1.28 (SD=1.0) subcategories of the ecosystem services of provision and regulation, respectively (Table 2.4).

Table 2.5 shows the ecosystem services identified through the two free-listings. In total, people referred to 24 different subcategories of ecosystem services. All the individuals listed, at least, one item of the provisioning services category. As many as 62 individuals listed items that could be included in the regulating services category, and 36 and 25 informants listed items that could be included in the cultural and supporting services categories.

Table 2.4. Descriptive statistic of variables on number of ecosystem services mentioned by people (n=91) from Kodagu (India, 2009).

Variable	Definition	Mean (Std. Dev.) or Frequency (and %)	Min-Max
Total categories of Ecosystem services	Categories of ecosystem services comprised in the items listed by informant (Possible range 1-4).	2.45 (0.96)	1 – 4
Total subcategories of Ecosystem services	Subcategories of ecosystem services comprised in the items listed by informant.	5.14 (2.76)	1 – 11
Provisioning	Provisioning services comprised in the items listed by informant.	2.90 (1.51)	1 – 7
Regulating	Regulating services comprised in the items listed by informant.	1.28 (1.00)	0 – 3
Cultural	Cultural services comprised in the items listed by informant.	0.48 (0.66)	0 – 2
Supporting	Supporting services comprised in the items listed by informant.	0.36 (0.66)	0 – 3

The most frequent subcategories of provisioning services derived from people's lists were food and fresh water supply (Table 2.5). All informants, except one, referred the service of food provision. This service was associated to items with nutritional values (e.g. rice, vegetables, food provision and honey provision) as well as with food sources (e.g. forest protection and agriculture support). The second most frequent subcategory listed was fresh water supply (n=49). This service came from items related to obtaining fresh water, but also water for domestic uses and for agriculture. There was a large difference in the frequency between the two most frequent ecosystem services that were mentioned. Other provisioning services referred by the informants included fiber, fuel, medicines, biochemical products, ornamental products, raw materials, and energy supply.

Of the category of regulating services, the most frequent subcategories were water regulation (n=50), air quality maintenance (n=48), and climate regulation (n=18) (Table 2.5). Water regulation included items referring to water for drinking and for irrigation and for the environment (e.g. water supply and maintenance). Air quality maintenance included items that people directly related to maintain a good air (e.g. air purification), or elements that contribute to the same goal (e.g. trees in general and forest protection). Climate regulation related to the maintenance of rain and temperature, mainly because of their importance for local agriculture. Other regulating services included regulation of human diseases and general protection.

Table 2.5. Ecosystem Services identified from items listed in free-listings (n=91, Kodagu, India 2009).

Ecosystem Services Classification	Items listed	Frequency
<b>Provisioning services</b>		91
Food	Coffee, pepper, rice, coconut, vegetables, mango, arecanut, food provision, honey provision, agriculture support, forest protection, wildlife survival, domestic animals survival	90
Fresh water supply	Water supply and maintenance, trees in general	49
Fiber	Trees in general, timber, bamboo, forest protection	32
Fuel	Firewood, oil	31
Medicine	Pepper, mango, tamarind, honey, plants in general, medicinal plants, ginger, lemon	25
Ornamental	Flowers, wild animals	14
Biochemical	Soap nut	10
Other services		7
Raw material	Stones, sand	3
Energy supply	Water, electricity	3
<b>Regulating services</b>		62
Water regulation	Water supply, water supply and maintenance, plant survival	50
Air quality maintenance	Trees in general, air purification, forest protection	48
Climate regulation	Climate regulation	18
General protection	Security support	1
<b>Cultural services</b>		36
Aesthetic	Flowers, plants survival, wildlife survival, domestic animals survival	26
Recreation and ecotourism	Forest protection, landscape maintenance, water supply	6
Spiritual and religious benefits	Coconut, plants in general, flowers	6
Sense of place	Shelter support	5
Company	Domestic animals	1
<b>Supporting services</b>		25
Other services	for living, human survival	15
General maintenance	Maintenance of all natural processes	7
Biodiversity refuge	Plant survival, animal survival, wildlife protection	6
Soil formation	Soil	4
Water cycling	Water supply and maintenance	1
Sun radiation	Sun light	9

The category of cultural ecosystem services includes four subcategories: aesthetic (n=26), recreation and ecotourism (n=6), spiritual and religious (n=6), and sense of place (n=5) (n=1) (Table 2.5). The subcategory aesthetic included items described as valuable assets in terms of

decoration (e.g. flowers and plants survival) and beauty (e.g. wildlife survival and domestic animals survival). Recreation and ecotourism included items described as special to spend leisure time (e.g. forest, water supply associated to falls, and landscape maintenance). Sense of place was explained as the support brought by ecosystems to maintain the locally valuable characteristics that favour a good living. People also listed items related to spiritual and religious benefits, which included some elements used in local ceremonies for praying (locally known as *pooja*) (e.g. coconut, plant in general, and flowers).

Finally, the category of supporting services included six subcategories. The subcategory general maintenance related to the contribution of nature to maintain the environment, agriculture, human life, and wildlife. The service of biodiversity refugee was also referred to by six individuals who mentioned that ecosystems are needed for the survival of plants and animals and for wildlife protection. Other subcategories of supporting services were soil formation (n=4) and the cycle of water (n=1). Fifteen individuals reported general items which were unable to be classified into any subcategory, so they were classified in an “other services” subcategory. People also mentioned the importance of sun light (n=9) for human and non-human life, including agriculture, human activities, and life maintenance in general. We kept sun light into supporting services category, although it is obvious that sun light does not come from local ecosystems.

### **Multivariate regressions**

Poisson regressions showed that four socioeconomic attributes explain differences in the number of ecosystem services mentioned by people: age, household wealth, level of schooling, and cultural background (Table 2.6). We found that younger individuals listed items covering more subcategories of ecosystem services than older individuals (coefficient=-0.007,  $p=0.01$ , row b, column 2). We also found that individuals with higher household wealth mentioned items covering more categories of ecosystem services than individuals with lower household wealth (coefficient=0.018,  $p=0.01$ , row c, column 1). Similarly, individuals with higher level of schooling also mentioned items associated to more categories (coefficient=0.078,  $p=0.005$ , row d, column 1) and subcategories (coefficient=0.124,  $p<0.001$ , row d, column 2) of ecosystem services than individuals with less formal education.

We also found differences across cultural backgrounds. For instance, items listed by non-Hindus covered more categories of ecosystem services than items listed by informants belonging to ST (coefficient=0.194,  $p<0.001$ , row f, column 1). Comparing the number of subcategories (model 2 of Table 2.6), we also found that people belonging to SC listed items

associated to fewer subcategories than people belonging to ST (coefficient=-0.408,  $p=0.07$ ). We also found that people from SC elicited items covering fewer subcategories of ecosystem services than non-Hindus (coefficient=0.403,  $p<0.000$ ; data not shown).

Poisson regressions also suggest that socioeconomic attributes of informants have a dissimilar association across categories of ecosystem services (columns 3 to 6, Table 2.6). For instance, age (row b, Table 2.6) bears a negative and statistically significant association with the number of services listed for provisioning (coefficient=-0.005,  $p=0.08$ ; column 3), regulating (coefficient=-0.010,  $p<0.001$ ; column 4), and cultural (coefficient=-0.021,  $p=0.005$ ; column 5), but not with the number of services listed for supporting services (column 6). Row [c] of Table 2.6 shows that individuals with higher household wealth listed items covering more number of regulating services (coefficient=0.053,  $p=0.001$ ; column 4) than individuals with lower household wealth, but no differences were found for provisioning (column 3), cultural (column 5), and supporting services (column 6). Regressions also showed that a higher level of schooling (row [d], Table 2.6) is associated with a higher number of regulating services (coefficient=0.331,  $p=0.002$ ; column 4), but not with the number of provisioning (column 3), cultural (column 5), and supporting services listed (column 6). Individuals who reported land ownership mentioned items covering a greater number of services in the supporting category (coefficient=1.199,  $p=0.02$ ; column 3) than individuals without land ownership. Last, regressions show that differences across cultural background appear only in the categories of provisioning and cultural services. Items elicited by people belonging to SC cover fewer provisioning (coefficient=-0.405,  $p=0.09$ ; row g, column 3) and cultural (coefficient=-0.435,  $p=0.06$ ; row g, column 6) services than items listed by people belonging to ST. Also, people belonging to OBC elicited items cover fewer supporting services than items elicited by people belonging to ST (coefficient=-0.540,  $p=0.04$ ; row h, column 6).

Last, results from our robustness analysis (not shown) suggested that the sign, magnitude, and level of statistical significance of the association coefficients did not change or slightly changed across models. In general, we observed that results changed when models were run only with male individuals and they were not clustered by settlements.

Table 2.6. Results of multivariate regressions between socioeconomic attributes and number of ecosystem services mentioned by informants (n=91) from Kodagu (India, 2009).

Socio-economic attributes	Total Categories of ES	Total of Sub-categories of ES	Number of services for each category			
			Provision	Regulation	Cultural	Support
	[1]	[2]	[3]	[4]	[5]	[6]
Male	[a] -0.040 (0.086)	-0.014 (0.034)	-0.004 (0.053)	0.176 (0.084)**	0.194 (0.125)	-0.943 (0.483)**
Age	[b] -0.003 (0.003)	-0.007 (0.003)**	-0.005 (0.003)*	-0.010 (0.001)***	-0.021 (0.007)***	-0.004 (0.008)
Household wealth	[c] 0.018 (0.007)**	0.041 (0.029)	0.034 (0.024)	0.053 (0.021)***	-0.006 (0.151)	-0.001 (0.096)
Schooling	[d] 0.078 (0.028)***	0.124 (0.025)***	0.041 (0.061)	0.331 (0.112)***	0.061 (0.222)	0.170 (0.202)
Land ownership	[e] 0.109 (0.207)	0.131 (0.213)	0.045 (0.121)	0.027 (0.179)	0.294 (0.682)	1.199 (0.536)**
Cultural background						
nH vs ST	[f] 0.194 (0.050)***	-0.004 (0.161)	-0.079 (0.240)	0.083 (0.239)	0.383 (0.426)	-0.118 (0.560)
SC vs ST	[g] -0.052 (0.123)	-0.408 (0.228)*	-0.405 (0.251)*	-0.441 (0.320)	-0.435 (0.229)*	-0.471 (0.511)
OBC vs ST	[h] 0.027 (0.110)	-0.066 (0.278)	0.035 (0.334)	0.015 (0.195)	0.015 (0.584)	-0.540 (0.272)**

Note: Cells show coefficient estimates of Poisson (columns 1 to 5) and maximum-likelihood logit model regressions (columns 6 and 7) and, in parenthesis, the standard errors. Models were run with Huber estimator of variance and clustered by settlement type (i.e. town, village, and adivasi colony). \*, \*\*, \*\*\* refer to significant levels at 10%, 5%, and 1%, respectively. Definition and descriptive statistic of variables see tables 2.1 and 2.4. In cultural background: Schedule Tribes (ST, omitted category), non-Hindus (nH), , Schedule Castes (SC), and Other Backwards Castes (OBC).

## Discussion and Conclusion

We structure the discussion around the two main topics of this work: i) items listed by people and their associations to ecosystem services, and ii) socioeconomic determinants of the local perception of ecosystem services.

People in our sample recognized a large range of ecosystem services from local agroecosystems, including provisioning, regulating, cultural, and supporting services. The high frequency of provisioning services mentioned by all informants suggests that they perceive these kinds of services as most meaningful (salient) and important. Provisioning services reflect the material dependencies on local ecosystems (Millennium Ecosystem Assessment, 2003), so the high frequency of food provision, mainly agricultural products, among people's answers is evidence of the high dependence of Kodagu residents on local agriculture and food



production. Results also show that other forms of material provision from agroecosystems, such as the provision of timber, firewood, medicines, and resources with special biochemical attributes (e.g. soapnut and its detergent attributes), are also locally important.

Although provisioning services were the dominating category, it is worth noticing that non-material uses also emerged from answers. Specifically, regulation services were the second most prominent service among all informants. People linked regulation services, in particular water purification and regulation, with the quality of food production. Informants mentioned that agriculture, their main subsistence base, largely depends on regulation and supporting services. This finding suggests that local people are aware of the close link between local food productions and the proper functioning of ecosystems. People also perceived that agroecosystems contribute to maintain local biodiversity. The important role of agroecosystems to conserve the threatened biodiversity of Western Ghats has been strongly emphasized by researchers (Bawa et al., 2007; Bhagwat et al., 2005a; Bhagwat et al., 2008; Garcia et al., 2009), and our analysis suggests that local people also recognise the regulating service of local agroecosystems for biodiversity maintenance. This finding is important as it suggests a common vision between local people and conservation biologists which has a clear implication for conservation biology (Garcia et al., 2009). Interestingly, however, people did not mention some important services categorized in the MEA. For instance, informants did not list any item related to pollination, or erosion control. Similarly, people did not refer to items about cultural services associated to cognitive systems, such as environmental education, scientific knowledge, or local ecological knowledge. We might suppose that services not referred to in this study are not prominent enough to be remembered by people in comparison with the listed services, or other services non listed but are only prominent for other local stakeholders (Hein et al., 2006).

With regard to the MEA category of cultural services, our informants described many material and non-material benefits of their environments that support religious belief and practices, contribute to a sense of place, and provide sources of beauty, leisure and a good life. As discussed in the introduction to this article, we recognise the problematic nature of *cultural services* (Wallace 2007), and that there are debates over what should be included in it. As currently conceptualised, it seems to us a catch-all category created to accommodate humans into the MEA's framework, and so it contains non-material benefit (beauty, leisure, identity, cosmology) and benefits not directly contributing to human livelihoods (materials for ritual or decoration). What it misses is that *all* human activities, including those benefitting from other

ecosystems services, are driven by culture as well. Furthermore, and as the theorists mentioned at the start of this article argue, for human societies, cultural knowledge, values, beliefs and social structures shape human interactions with the environment, and thus drive the use and manipulation of the environment to provide services that people need. Thus, many ecosystem services relevant to human needs do not exist *a priori* in Nature. Agroecosystems in Kodagu are an excellent example of a landscape level biocultural process, whereby human activities and cultivated areas have co-evolved over time, and now provide many services identified by our informants as important and that the MEA framework would consider as cultural.

Our results also suggest a high level of local awareness of the linkages between ecosystems and human well-being. People recognized that ecosystem services, particularly provisioning services, contribute largely to maintain the livelihood either through self consumption or commercialization. Likewise, informants were conscious of the role that local ecosystem services can play in increasing household's security and resilience to shocks and unexpected events. On the one hand, because services provided by local ecosystems decrease households dependence on cash income and fluctuations in market prices (Delang, 2006), and, on the other hand, because they allow for the transformation of natural products (or natural capital) into other forms of economic capital that contribute to household subsistence (Godoy et al., 2002). Results from our study complement findings from our previous research highlighting that natural assets are keystone elements on the wellbeing of individuals in Kodagu (Chapter 1). Our findings also dovetail with previous research suggesting that provisioning services are the most prominent or valuable ecosystem services for societies, as they bear a close and direct connection to human well-being (Folke et al., 2005; Millennium Ecosystem Assessment, 2003; Pereira et al., 2005; Rodriguez et al., 2006). It is important to note that similar results have been obtained by researchers using different methods. For instance, whereas we used cultural consensus techniques, Pereira and collaborators (2005) used rapid rural appraisal and the participatory rural appraisal approaches. They also found that people from rural communities in Portugal also felt that provisioning services are the most important for well-being. Similarly, Rodríguez and collaborators (2006), using cultural consensus analysis, contingent valuation and market information, found that provision function of ecosystem is the most important service for local people from Peru. Indeed, provisioning services seem to be the most important ecosystem services perceived by several local communities, but it is important to emphasize that it is the view of a particular stakeholder on local ecosystems. As

emphasized by Hein and collaborators (2006), different stakeholders have different interests in ecosystem services.

These close relationships between natural assets and human wellbeing are particularly critical for individuals without legal access to natural resources. Our understanding is that despite restrictions on forest access, for example for grazing and harvesting of NTFPs, poor and landless households continue to use forests (and other ecosystems) irrespective of whether they have legal access to do so or not, though they may be forced to pay small fines or bribes. Increased protection and enforcement of laws to protect forests, biodiversity and other resources would then put a great burden on the livelihoods and well being of these groups, which could lead to conflicts among resources users and even threaten biodiversity (Garcia et al., 2009; see also Puri and Donovan 2005). In this scenario, policy aims to improve both local wellbeing and protect wildlife would be under risk. In line with other community-based approaches to conservation (Berkes 2007), those biodiversity assets that contribute to maintain ecosystem services that assure a fulfilment of wellbeing should take priority in conservation planning (Sheil et al., 2006; Costanza et al., 2007; Fisher et al., 2009; Wallace, 2007).

Our second important finding relates to the role of socio-economic attributes on people's perceptions of ecosystem services. We found that four socioeconomic attributes (age, household wealth, schooling, and cultural background) influence the number of ecosystem services that an informant is aware of. Our analysis also shows, however, that the relations of socioeconomic attributes and perceptions of ecosystem services differed significantly across categories of services. The most noteworthy difference is found in the perception of regulating services among people with different socioeconomic attributes. This finding suggests that, for some categories (i.e. cultural services), there is a consensus among people on the services offered by agroecosystems, whereas for other categories (i.e. regulating services) there are diverse ways of uses depending on social groups.

First, we found a negative association between an individual's age and the number of services listed. We explain this association in light of the different activities currently carried out by individuals. Our field observations suggest that younger individuals often manage or work in coffee plantations, whereas older individuals spend more time at home, or in subsistence activities. Similarly, previous ethnographic research has described that participation in the collection of natural resources decreases between 40 and 50 years-old among tribal individuals from Kodagu (Demps et al., 2012).

Second, our results show that a higher number of services are elicited by individuals with higher wealth. Reyes-García and collaborators (2011), working on benefits provided by water tanks in Tamil Nadu (India), also found that the wealth of a person was positively associated to the number of uses of water tanks described by people. Since in the study area, wealth is closely related to agricultural activities, our finding may be explained by the larger level of involvement on agricultural activities of people with higher household wealth, which in turn would relate to the possibility to perceive greater number of ecosystem services, when compared with people less involved in agriculture. Third, we also found a positive association between schooling (i.e. formal education) and number of services perceived by people. This finding suggests that the level of formal education might determine the awareness about the diverse range of services offered by local ecosystems.

Last, like Reyes-García and collaborators (2011), we also found differences in the perceptions of ecosystems between different cultural backgrounds. We found that people belonging to ST elicited items covering more ecosystem services than people from SC. This may be explained by differences in how people with different cultural backgrounds interact with their surrounding environment. For instance, people from ST have had longer and closer relationships with the local environment than people from SC, which might explain the greater number of ecosystem services perceived by people from ST.

In summary, our results suggest that agroecosystems are locally perceived as source of multiple ecosystems services beyond the production of food (see Calvet-Mir et al. 2012 for a similar result). In fact, people perceive a myriad of material and non-material services provided by local agroecosystems. One of the main services described by people is the food production for self-consumption and commercialization. Our results also suggest that ecosystem services are perceived in different ways by people with different socio-economic characteristics. Specifically, younger, wealthier, and more educated individuals perceive more ecosystem services than people without those characteristics. People from different cultural backgrounds also have different perceptions from agroecosystems services.

We conclude by outlining two policy suggestions. First, since agroecosystems have both social and biological relevance, policies regulating those agroecosystems should assure a sustainable access to ecosystem services or should compensate for the lack of it. Policy makers should recognise that degradation of agroecosystems will potentially reduce the value of rural landscapes for both people and wildlife. Our study brings a list of ecosystem services and their frequency of mentions that would help focus policy decisions in this area. Second, since

perceptions and uses of agroecosystems differ across social groups, policies should take into account that any measure regarding the management of agroecosystems will have dissimilar effects across social groups. Our findings also urge policy makers to take more bottom-up as opposed to top-down, generic, blueprint approaches to planning interventions (Berkes 2007).

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**Chapter 3:**  
**The role of natural and economic capital on subjective  
well-being: Empirical evidence from a small-scale society  
in Kodagu (Karnataka), India.**

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**Abstract**

Standard economic approaches have traditionally neglected the role of natural capital as a fundamental source of human well-being. The economic literature has mainly focused on the effects of economic or human-made capital. The focus of this paper is to explore the linkages between human well-being and the two forms of capitals. Using empirical data from 171 individuals from a small-scale Indian society, we found positive associations between well-being and both forms of capitals. Nevertheless, capitals differed each other on their relative contributions to overall well-being as well as across dimensions of well-being (subsistence, security, and reproduction and care). Our results evidence the role of natural capital on well-being. Even more, results suggest that natural capital can become more important than economic capital on the fulfilment of overall well-being and its dimensions among individuals from small-scale societies. Our findings support ongoing calls for explicitly incorporating ecosystem services in the policy design focused on measuring and improving human well-being.

**Key words:** Ecosystem services, life satisfaction, dimensions of human well-being, Human Scale Development, Western Ghats, Karnataka.

## Introduction

Designing effective ways to improve human well-being is a major concern for public policies (Costanza et al., 2007; Diener and Suh, 1997; Easterlin, 2001a, b; Easterlin, 2003; Easterlin et al., 2010; Hagerty et al., 2001; Layard, 2010; Max-Neef et al., 1993; Millennium Ecosystem Assessment, 2003). For the last 30 years, most efforts to improve human well being have concentrated in economic assets, mainly income and wealth creation (Dolan et al., 2008). The approach is based on the idea that income and material wealth are the prominent determinants of human well-being mainly through the acquisition of manufactured goods (Dolan et al., 2008; Ferrer-i-Carbonell, 2005; McBride, 2001; Ovaska and Takashima, 2006; Vemuri and Costanza, 2006). Several indexes of well-being (Genuine Progress Index, Human Index Development, Index of Economic Well-Being, International Living Index, among other) have been built under the economic approach around the world (Hagerty et al., 2001). However, a main gap in the specialized policies and scientific literature is the lack of attention to ecosystems as a fundamental source of human well-being (Costanza et al., 2007; Dolan et al., 2008; Helliwell et al., 2012). Here, we contribute to address this gap assessing the impact of ecosystem on human well-being in an empirical case study conducted in a small-scale society from India. We also compare the relative role of natural and economic assets as factor on well-being, thereby shedding light on existing controversies regarding the complementarity vs. substitutability relation of natural and man-made capital in the scientific literature (Costanza and Daly, 1992).

Despite the focus of the prominent approach to measure well-being keeps resting in economic capital, a growing number of works on the relation between income and wellbeing suggests that the relation between those two variables is far from linear. More than four decades ago, Easterlin (1974) already noted that although at any particular time richer individuals enjoy more subjective well being than poorer ones, once certain thresholds have been reached societies do not report higher levels of well being as income increases. In a similar perspective, Max-Neef (1995) has proposed the "Threshold Hypothesis" that states that, at low levels of income, economic growth does bring an improvement in human well-being, but only up to a point -the threshold point- beyond which, more economic growth does not necessarily implies higher well-being.

A main limitation of using only economic indicators as a measure of quality of life comes from the alleged multidimensional nature of well-being" (Alkire, 2002; Costanza et al., 2007; Dodds, 1997; Hagerty et al., 2001; Max-Neef et al., 1993). For example, the Human Scale Development

(HSD) framework (Max-Neef et al., 1993) conceptualizes well-being as comprising different dimensions that cover all fundamental human needs. Those fundamental needs include subsistence, security, reproduction and care, affection, understanding, participation, leisure, spirituality, creativity, identity, and freedom (Alkire, 2002; Costanza et al., 2007; Max-Neef et al., 1993). All dimensions of human well-being can be fulfilled by a diverse set of material and non-material elements, called satisfiers (Max-Neef et al., 1993). But, how people define well-being, what are the dimensions which should be given priority, and what satisfiers are available to fulfil the different dimensions depend upon particular geographical conditions, cultures, and historical periods (Max-Neef et al., 1993; Rawls, 1999). Thus, because human well-being includes multiple dimensions and because satisfiers can vary from one society to another, it is not surprising that one single factor –income- cannot fully explain how human well being is fulfilled or not and to which extent.

Researchers have operationalized the idea of “satisfiers” as the goods, services, and factors that can help humans to attain well-being (Cruz et al., 2009; Max-Neef et al., 1993). Satisfiers come from different assets, often portrayed as distinct forms of capital (Costanza and Daly, 1992; Costanza et al., 2007; Chiesura and de Groot, 2003; Dodds, 1997; Fenech et al., 2003; Victor, 1991). Thus, in addition to the economic capital -or manufactured goods such as tools, equipment, buildings and technology-, other forms of capital that can also offer satisfiers of well-being, such as social capital, human capital, and natural capital (Costanza and Daly, 1992; Costanza et al., 2007; Chiesura and de Groot, 2003; Dodds, 1997; Fenech et al., 2003; Victor, 1991).

The focus of this paper is on natural capital, defined as the renewable and non-renewable goods and services provided by ecosystems to human societies (cf. Daly, 1994), and analyzed as a source of satisfiers for human well-being. In the last two decades multiple authors (Costanza and Daly, 1992; Costanza et al., 2007; Dolan et al., 2008; Ferrer-i-Carbonell and Gowdy, 2007; Millennium Ecosystem Assessment, 2003; Pereira et al., 2005; Rehdanz and Maddison, 2005; Welsch, 2006, 2007, 2009) and several policy initiatives (Millennium Ecosystem Assessment, 2003; TEEB, 2010) have stressed the role of natural capital in human well-being. For example, the Millennium Ecosystem Assessment (2003) proposes that there is a direct link between human well-being and natural capital, and that this link is mediated by goods and services provided by ecosystems. Furthermore, according to Costanza and colleagues (2007), unlike the economic capital, natural capital contributes to all dimensions of human well-being, and specially plays a major role in the fulfilment of the subsistence

dimension. Likewise, the initiative 'The Economics of Ecosystems and Biodiversity' (TEEB, 2010) analyzes the impact of biodiversity loss in well-being, stressing that it becomes especially relevant among rural and low income societies with limited access to technology.

However, and despite of the vast emerging literature on the topic, few studies have actually assessed on an empirical basis the contribution of natural capital to human well-being among ecosystem dependent rural and indigenous communities (Dolan et al., 2008; Helliwell et al., 2012). The few empirical studies about the relation between human well-being and natural and economic capitals conducted with indigenous populations provide contrasting results about the relative importance to human well-being of those two types of capitals. For example, research conducted among an indigenous society in the Bolivian Amazon suggests that, in this society, economic factors were not central in determining subjective well-being, implying that subjective well-being is mainly dependant on other satisfiers, like natural capital (Masferrer-Dodas et al., in press). Contrarily, in research among poor indigenous farmers from Peninsular Malaysia, Howell et al. (2006) found a positive association between economic variables and subjective well-being.

In this research, we shed light on this controversy by providing empirical evidence of the contribution of natural and economic capital to human well-being among forest dwellers from Kodagu district of Karnataka State (India). Specifically, (a) we estimate the relative contribution of natural and economic capital to subjective well-being, and (b) we compare those relative contributions across three dimensions of well-being: subsistence, security and reproduction and care (Costanza et al., 2007; Max-Neef et al., 1993).

## **Study site**

### **Environment, economy and people in Kodagu**

Kodagu district is located in the south of Karnataka State, India (75°25'-76°14' E and 12°15'-12°45' N). Kodagu's landscape is composed by agroecosystems of coffee plantations (60% of the total land surface) and by evergreen and deciduous forests (Garcia et al., 2009). The evergreen and deciduous forests of Kodagu are large remnants of the endangered tropical biodiversity and are part of the "Western Ghats" biodiversity hotspot (Myers et al., 2000). This natural capital (including natural resources and ecosystem services) contributes in many ways to local livelihoods, for example by satisfying nutritional, medicinal, economic, and religious needs and wants (Demps et al., 2012; Dowie, 2009; Laval, 2008; Ormsby, 2011). Nevertheless,

there is a strong regulation over the access to natural resources in Kodagu. For instance, collection of natural products inside of protected areas is totally prohibited, and people need licence to collect natural resources for commercialization from other areas (Demps et al., 2012). Although a recent act (Forest Right Act, 2006) may improve local access to natural resources and ecosystem services (Macura et al., 2011), lands and resources access has become a sensitive issue between local people and governmental institutions.

Kodagu's economy is based on exploitation and use of natural capital as source of an alleged local development. The economic activity of the district is based mainly on coffee production (Ninan and Sathyapalan, 2005). Kodagu is one of the major coffee-growing regions in India, contributing nearly 2% of the world's coffee production (Coffee Board of India, 2008). Most people in Kodagu are somehow related to the coffee business, either in farm management, or coffee cultivation, harvesting, or sale. Pepper, rice, ginger, and cardamom are other important cash crops in Kodagu.

Our study focuses on a small-scale society of forest dwellers, mainly adivasi or people from scheduled tribes. The term *adivasi* comprises a heterogeneous set of ethnic and tribal groups defined as the aboriginal population of India. According to the 2001 census, 8.4% (or 46000 individuals) of the total population of Kodagu belongs to Scheduled Tribes (Government of Karnataka, 2006). The most populous tribes in the district are Jenu-Kuruba, Betta-Kuruba, Soliga, and Yerava. Often, forest dwellers live in settlements established by the government during the 1960's and 1970's, locally known as colonies. Some people in adivasi colonies still maintain their ancient lifestyle, culture, and traditions, especially those who are settled far from urban areas inside forest, in remote and inaccessible terrain largely devoid of modern amenities and technology (Demps et al., 2012; Dowie, 2009; Kshirsagar and Singh, 2001). However, people in other adivasi colonies are increasingly immersed in the market economy and in modern lifestyles, often working in remunerated jobs, such as in the Forest Department or on local farms. Some people belonging to Scheduled Castes (SC) or Other Backward Castes (OBC) are also settled in adivasi colonies. The population of adivasi colonies located outside forest is more mixed than the population of colonies inside the forest. The household economy of adivasi families is mainly based on gathering of forest products, livestock raising, and agriculture for both self-consumption and commercialization. In less remote settlements, household also obtain income from temporary wage labour, mainly in coffee states, forest management (with Forest Department), and construction of roads and houses. They also

obtain some cash income by selling honey and other minor forest products to government-sponsored societies (Demps et al., 2012).

### **Human well-being among adivasi in Kodagu**

Kodagu is one of the wealthiest districts in Karnataka. In 2005, Kodagu ranked fourth out of the 27 districts of Karnataka in the ranking of Human Development Index (Government of Karnataka, 2006). Only 4.9% of Kodagu's population was living below the poverty threshold in the 1999-2001 period. However, the government acknowledges that much remains to be done in order to improve Kodagu's well-being, especially among adivasi people (Government of Karnataka, 2006). Adivasi colonies usually do not have access to safe drinking water, electricity, toilets, and education. Kodagu in particular is among the districts with lowest ratio of school enrolment among adivasi (Government of Karnataka, 2006). The well being of adivasi people is supported by the government through the provision of social services, infrastructure, and programs aiming at poverty reduction (Government of Karnataka, 2006). For instance, adivasi families receive subsidies for food and others basic needs through the Public Distribution System. Furthermore, the government sponsored societies, called Large-scale Adivasi Multi-Purpose Societies (LAMPS), promote tribal development integration and economic solvency by supporting the commercialization of forest products.

Nevertheless, one of the gaps at Kodagu level is that public policies on well-being do not fully capture local realities or definitions of well-being. In previous research on the area (Chapter 1), we found that economic indicators cover only one set of the factors that people self-report to define their well-being. In fact, people reported a diversity of elements (i.e. quality of environment, health, and social relations) as important in defining their well-being. Several of the local elements are not included into current well-being measures, which has been highlighted as a potential obstacle in the quest of designing policies aimed at improving the well-being among people from Kodagu.

## **Methodology**

### **Data collection and sample**

We collected quantitative data between January and April 2010. Specifically, we administrated a questionnaire to capture information on i) human well-being (outcome variable), ii) natural capital and economic capital (explanatory variables), and iii) socioeconomic attributes of the individuals (control variables). The questionnaire was constructed on the basis of our previous



research on human well-being (Chapter 1) and natural capital (Chapter 2) on the study area. Our sample includes 171 randomly selected adults from 16 adivasi colonies. Adivasi colonies were randomly selected from the official list of colonies provided by Tribal Welfare Office. To assure a random selection of households, our protocol of sampling included flipping a coin to decide whether a given household was included or not in the sample. In each selected household, we interviewed adults willing to answer the survey. We worked with assistance of local translators from Kannada (local language) to English.

**(a) Outcome variables: Well-being and its dimensions**

We measured human well-being through individual self-reports (Easterlin, 2003; Layard, 2010). In addition to the overall measure of subjective well-being, we also measured individual satisfaction on three specific dimensions of well-being: subsistence, security, and reproduction and care.

Overall Subjective well-being: There is a general consensus that subjective well-being, based in people's own perceptions, is a meaningful approach to measure human well-being and comparable it among group of individuals (Easterlin, 2003). We followed the standard approach to measure subjective well-being (Easterlin, 2003; Layard, 2010) and asked informants the following question: "If you think about all the good and bad aspects of your life, how satisfied are you with your life as a whole?" We prompted individuals to provide answers in a value scale from 0 to 5, where 0 referred to "very unsatisfied" and 5 to "very satisfied". To improve the intuitive understanding of the answer scale, we used smile faces to represent the values.

Satisfaction of dimensions of well-being: We used results from previous research (Chapter 1) to identify elements locally considered as relevant to improve well-being. We categorized those elements in the dimensions of well-being proposed by Max-Neef et al. (1993) and Costanza et al. (2007). Since most of the reported elements corresponded to the dimensions of subsistence, security and reproduction and care, we limited the rest of our analysis to these three dimensions. We constructed three questions to capture the individual level of satisfaction with each of those three dimensions. To ensure people's understanding of the question, we phrased two questions using concrete examples of elements that people associate to those dimensions. For example, to assess people's satisfaction with the subsistence dimension, we asked about satisfaction with water availability, food, shelter, and clothing; to assess people's satisfaction with the security dimension, we asked about satisfaction with electricity facilities, income, ration program, job opportunities, transport

facilities, and health facilities; and to assess people's satisfaction with the reproduction and care dimension, we asked about satisfaction with nutrition, well-being, and children's education (Chapter 1). For each dimension, we also asked a more general question using the terms "survival", "individual security", and "security of the family" for the dimensions of subsistence, security, and reproduction and care, respectively. We assessed the suitability of our phrasing through discussions with individuals and leaders of adivasi colonies. All the questions addressed at each of the dimensions followed the same phrasing structure. As in the question addressing overall well-being described above, every time, we prompted individuals to provide answers in a scale of six values from 0 to 5, where 0 referred to "very unsatisfied" and 5 to "very satisfied". To get an index of satisfaction for each dimension, we took the average of three questions.

**(b) Explanatory variables: Natural capital and economic capital**

For each type of capital, we included (i) a subjective measure capturing the level of satisfaction of the individual with the specific form of capital as satisfier of well-being, and (ii) an objective measure, consisting of objective indicators identified in our previous work (Chapter 1 and 2). We used both subjective and objective measures of capitals because it is also possible for indicators of capitals measured subjectively to move in one direction while objective indicators of capitals move in another direction (Godoy et al., 2009).

Natural capital:

a) Subjective measure: We captured individual level of satisfaction with the local ecosystem and its services, which in essence represents individual level of satisfaction with natural capital. To do so, we used the same structure used to assess well-being questions. Specifically, we asked: "If you think about all the good and bad of the ecosystems around their village, how satisfied are you with the ecosystems?" The answer also was given in a scale of six values.

b) Objective measure: We asked individuals about access to and tenancy of a set of locally relevant elements of natural capital (based on evidence from the chapter 2). Specifically, we asked individuals about (a) household livestock ownership (i.e., number of pigs, goats, and chicken) and calculated the kilograms of available meat, (b) home garden diversity, or number of existing edible plants in the home garden, (c) cash-crops diversification, or number of natural products collected among the seven major products in the area (i.e. coffee, pepper, coconut, mango, bamboo, soap nut, and Mara genasu), (d) agricultural diversity, or number of

different crops cultivated in the household's lands, and (e) number of acres of land under cultivation.

#### Economic capital:

a) Subjective measure: As for natural capital, we asked "If you think about all the good and bad of your household economy, how satisfied are you with your economy?" The answer also was given in a scale of six values.

b) Objective measure: We used the following standard indicators of economic capital: (a) household income during the month prior to the interview, in Indian rupees (1 € = 62.5 INR, February 2010), (b) household wealth (or monetary value of a set of manufactured goods owned by the household, including cell phone, motorbike, bicycle, television, radio, Table, and chairs), (c) availability of basic facilities for the household (measured by a binary variable to determine presence (=1) of toilet and electricity facilities, and (d) house construction material (measured by a binary variable that took the value of 1 if the house was solid). In the data analysis, we used the household wealth in natural logarithm.

#### **(c) Control variables: Socioeconomic attributes of the individuals**

We asked individuals about their (i) schooling level (classified as none, primary, secondary, incomplete superior, or complete superior level), (ii) age, (iii) sex (male=1), (iv) health status – coded as 1 if the person declared that he/she has been unable to work during the month preceding the interview, and (v) ethnicity (schedule tribes origin codified as 1, 0 otherwise). We also recorded village location, and generated a dummy variable that we coded as 1 when the village was located outside the forest.

#### **Estimation Strategy**

Our estimation strategy tests the associations between natural and economic capital (explanatory variables) and human well-being (outcome), while controlling for other socioeconomic attributes of individuals that have been related to well-being. As proxies of well-being, we used (i) overall subjective well-being, and satisfaction with the three dimensions of well-being selected (ii) subsistence, (iii) security, and (iv) reproduction and care. As explanatory variables, we used either the subjective or the objective measures of natural and economic capital. In the case of objective measures, we used a factorial analysis with the maximum-likelihood method to create a unique index from all objective measures captured for each type of capital (Vyas and Kumaranayake, 2006). Then, we ran a series of multivariate

Ordered Probit regressions to estimate the associations between natural and economic capital. For the empirical analysis, we used the following expression:

$$[1] \quad Y_{ihc} = \alpha + \beta NC_{ihc} + \gamma EC_{ihc} + \delta S_{ihc}$$

The expression [1] assumes that  $Y$  captures the level of overall subjective well-being of individual  $i$  from household  $h$  in colony  $c$ . For ease of explanation we use overall subjective well-being, but the expression also applies for the three specific dimensions of well-being measured (i.e. subsistence, security, and reproduction and care).  $NC$  refers to our proxies of natural capital and  $EC$  captures the variables that proxy economic capital.  $NC$  and  $EC$  refer to either subjective or objective measures (depending on the model);  $S$  is a vector of control variables;  $\alpha$  refers to the constant of the model;  $\beta$ ,  $\gamma$ , and  $\delta$  are the coefficients of the associations between natural capital, economic capital, and controls with well-being. We run all regressions using the Huber variance estimator in case our variables did not fulfil the normality assumptions (Cameron and Trivedi, 2009).

We carried out a robustness analysis to assess the consistency of our results. To do that, we disturbed our models by i) dropping intentionally some control variables, ii) running regressions with selected parts of the sample, and iii) using Ordinary Least Square (OLS) instead of Ordered Probit regressions.

## Results

### Subjective well-being and its dimensions

The descriptive analysis of our measure of subjective well-being suggests that forest dwellers from Kodagu were under the mid-point (2.5) in the scale used in the analysis, although variation among subjects was large (mean=1.84, SD=1.82) (Table 3.1). Sixty-one individuals (35.7% of the sample) reported to be totally unsatisfied with their life, whereas 25 individuals (14.6%) reported to be totally satisfied. Furthermore, the level of satisfaction differs across the three dimensions of well-being analysed in this study. In average, satisfaction with the dimension of subsistence was 2.91 (SD=1.76). People reported an average satisfaction with security dimension of 2.37 points (SD=1.52). Last, the reproduction and care dimension had the highest average of satisfaction among the three studied dimensions (mean=3.92, SD=1.21) (Table 3.1).

### Natural capital and economic capital

Table 3.2 shows the descriptive statistic of our subjective and objective measures related to natural and economic capital. Our subjective measure suggests a high level of satisfaction with local ecosystem as satisfier of well-being (mean=4.59, SD=0.93), but a medium level of satisfaction with economic capital (mean=2.69, SD=2.1). Most people (134 or 78.3% of the sample) reported to be totally satisfied with the contribution of local ecosystems to their well-being, whereas only 58 individuals (33.9%) mentioned to be totally satisfied with the contribution of their economic capital to their well-being. Contrastingly, while only three individuals (1.8%) were totally unsatisfied with the contribution of local ecosystems to their self-perceived well-being, 44 individuals (25.7%) reported a total unsatisfaction with the corresponding contribution of the household's economic capital.

Results on objective measures of access to different forms of natural capital suggest a high variability among people in the sample (Table 3.2). For instance, the average household owned livestock meat equivalent to 31.87 kg, but with a standard deviation of 62.16 kg. Similarly, the

Table 3.1: Dimensions of subjective well-being among tribal individuals (n=171) from Kodagu (Karnataka, India, 2010).

Variables	Definition	Mean	Std. Dev.	Min-Max
Subjective well-being	Overall individual level of satisfaction with life in a scale from 0 (totally unsatisfied) to 5 (totally satisfied).	1.84	1.82	0-5
Satisfaction with Subsistence	Individual satisfaction with the fulfilment of basic material needs (i.e., house, cloths, food, and water availability) in a scale from 0 (totally unsatisfied) to 5 (totally satisfied).	2.91	1.76	0-5
Satisfaction with Security	Individual satisfaction with the fulfilment of personal security (i.e. income, job opportunities, governmental ration programs, transport, electricity, and health facilities) in a scale from 0 (totally unsatisfied) to 5 (totally satisfied).	2.37	1.52	0-5
Satisfaction with Reproduction and care	Individual satisfaction with the fulfilment of household well-being (i.e., security, education, and nutrition) in a scale from 0 (totally unsatisfied) to 5 (totally satisfied).	3.92	1.21	0-5

Table 3.2: Descriptive statistics of natural and economic capital variables (both subjective and objective measures), and control variables used in regression analysis.

Variables	Definition	Mean	Std. Dev.	Min-Max
<b>Natural Capital variables</b>				
Subjective measure				
Satisfaction with local ecosystems	Individual satisfaction with ecosystems around the colony in a scale from 0 (totally unsatisfied) to 5 (totally satisfied).	4.59	0.94	0-5
Objective measures				
Household livestock ownership	Estimated kilograms of livestock (pig, goats and chicken) own by the household.	31.87	62.16	0-477.6
Homegarden diversity	Number of edible species (fruits and vegetables) in the home garden.	4.12	2.56	0-13
Cash-crop diversification	Number among seven natural resources (coffee, pepper, coconut, mango, bamboo, soap nut, and local potato) collected during last month.	3.17	1.62	0-7
Agricultural diversity	Number of types of crops cultivated in the property.	1.52	1.18	0-5
Cultivated land	Number of acres cultivated by household.	0.96	1.37	0-10
<b>Economic capital variables</b>				
Subjective measure				
Satisfaction with household economy	Individual satisfaction with household economy. Answer in a scale from 0 (totally unsatisfied) to 5 (totally satisfied).	2.69	2.10	0-5
Household Income	Rupees earned through wage labor or the sale of products by members of the household during the month previous to the interview (in thousands of Indian Rupees; 1 € = 62.5 INR, February 2010)	7.99	12.31	0-150
Household wealth	Monetary value of manufactured goods (such as chairs, tables, televisions, bicycles, and motorbikes) in the household (in thousand of Indian Rupees). We used the natural logarithm in the analysis.	4.19	5.93	0-34.33
Basic facilities	Dummy variable that captures the presence in the household of electricity or toilet facilities (=1), or the absence of both, (=0).	36%		
House material	Dummy variable that captures whether the house is constructed in solid material (=1), or otherwise (=0).	62%		

Table 3.2: Descriptive statistics of natural and economic capital variables (both subjective and objective measures), and control variables used in regression analysis.

Variables	Definition	Mean	Std. Dev.	Min-Max
<b>Control variables</b>				
Schooling	Level of schooling of the individual. 0=none, 1=primary, 2=secondary, 3=incomplete superior, and 4=complete superior.	0.92	1.18	0-4
Age	Age of Individual (in years)	38.57	15.66	16-85
Male	Sex of the individual (1=male).	43%		
Illness	Individual reported having been ill in bed, unable to work, during last month (1=yes).	33%		
Scheduled Tribes	Individual belongs to schedule tribes group (1=yes).	83%		
Outside the forest	Percentage of Individuals living outside reserve forest and protected areas (1=yes).	8%		

average surface of land for cultivation in a household was of 0.9 acres with a standard deviation of 1.4 acres. Twenty-eight individuals (16.4%) reported not to have any land under cultivation, while five individuals (2.9 %) reported to have more than 5 acres for cultivation. Results of the factor analysis suggested that natural capital variables converged into a single factor (Eigenvalue=1.25), although the internal consistence of our measures was low (Cronbach's alpha=0.57).

### Natural capital and economic capital in subjective well-being

In Table 3.3, we test the association between individual's satisfaction with local ecosystems and with the household economy (explanatory) and her/his subjective well-being (outcome). Our results suggest a positive and statistically significant association between satisfaction with the local ecosystems and the overall subjective well-being (coefficient=0.258,  $p=0.03$ , row[a], Column [1], Table 3.3). Satisfaction with the household economic was also associated in a statistically significant and positive way with overall subjective well-being (coefficient=0.128,  $p=0.008$ , row[b], Column [1], Table 3.3).

The analysis in Table 3.4 is similar to the analysis presented in Table 3.3, except that we use objective rather than subjective measures of natural and economic capitals. Our results suggest that both natural and economic capital were positively associated to subjective well-being, but the associations were statistically insignificant (row [a] and [b], column [1], Table 3.4).

### **Dimensions of well-being vs natural and economic capital**

Tables 3 and 4 show the results of the models using the three selected dimensions of well-being as dependent variables (column [2]-[4]). We found a positive and statistically significant association between an individual's satisfaction with natural and economic capital and his/her satisfaction with each well-being dimension analyzed (rows [a] and [b], columns [2]-[4], Table 3). Satisfaction with ecosystems bears a similar association, in terms of magnitude and statistical significance, with the three dimensions of well being measured (row [a], columns [2]-[4], Table 3.3). Satisfaction with household economy bears a stronger association with the subsistence (Coefficient=0.323,  $p < 0.001$ , row [b], column [2], Table 3.3), than with the security or the reproduction and care dimensions (row [b], column [3] and [4], Table 3.3).

Objective measures of economic capital also show high variability. For instance, the average household income during the month preceding the interview was 7998 INR, but with a standard deviation of almost twice this value (S.D.= 12318.9 INR). Thirty-five households in our sample (20.5%) did not own any of the manufactured goods included in our list. Results also suggest that a low percentage (36%) of the sample has access to basic facilities (i.e. toilet and electricity), and that a large number of families live in huts (65, or 38% of total sample). Factor analysis of these objective measures also converged into a single factor (Eigenvalue=1.33) and, as in the case of natural capital, their internal consistence was also low (Cronbach's alpha=0.58). For both types of capital, we argue that the lack of high internal consistency arises from the large complexity of both concepts of capitals and the hard task that implies to capture them.

In regressions using objective measures for natural and economic capital (Table 3.4), we found that those measures were not always associated with the three dimensions of well-being. Objective measures of natural capital only bear a positive and statistically significant association with satisfaction with the dimensions of security and reproduction and care (row [a], columns [3] and [4] of Table 3.4). In turn, objective measures of economic capital were associated in a positive and statistically significant way with the level of satisfaction with the subsistence and security dimensions (row [b], columns [2] and [3] of Table 3.4), but not with the reproduction and care dimension (row [b], columns [4] of Table 3.4).



Table 3.3. Associations of subjective well being and its dimensions against subjective measures of capital types among tribal individuals (n=171) from Kodagu (Karnataka, India, 2010).

Explanatory variables: Subjective measures of capital forms		Outcome Variables:			
		Subjective Well-being	Satisfaction with dimensions of well-being		
			Subsistence	Security	Reproduction and Care
		(1)	(2)	(3)	(4)
Satisfaction with ecosystems	(a)	0.258 (0.119)**	0.261 (0.092)***	0.203 (0.086)**	0.252 (0.105)**
Satisfaction with household economy	(b)	0.128 (0.048)***	0.323 (0.042)***	0.161 (0.042)***	0.115 (0.041)***
Schooling	(c)	0.064 (0.083)	0.174 (0.085)**	0.019 (0.079)	0.193 (0.084)**
Age	(d)	-0.009 (0.007)	0.001 (0.006)	-0.002 (0.006)	0.001 (0.006)
Male	(e)	0.344 (0.180)**	0.155 (0.168)	0.130 (0.168)	0.060 (0.190)
Illness	(f)	-0.507 (0.209)**	-0.272 (0.201)	-0.473 (0.199)**	-0.022 (0.189)
Scheduled Tribes	(g)	0.461 (0.196)**	0.162 (0.206)	-0.390 (0.242)	0.138 (0.239)
Outside the forest	(h)	0.819 (0.288)***	1.055 (0.302)***	0.746 (0.366)**	-0.297 (0.393)

Note: Cells show coefficient estimates of ordered probit regressions and, in parenthesis, the standard errors. Models were run with robust estimator of variance. \*, \*\*, \*\*\* refer to significant levels at 10%, 5%, and 1%, respectively. For definition of variables see Tables 3.1 and 3.2.

### Robustness analysis

The sign, magnitude, and statistical significance of the coefficients of almost all associations did not change, or slightly changed, in the robustness analysis. We basically found that coefficients changed substantially when we ran the models only with male individuals. In the Table 3.5, for instance, we show the results of the robustness analysis using only overall subjective well-being as outcome variable. Regressions only with male individuals (model 6) suggested that subjective well-being was associated in a positive and statistically significant way with the satisfaction with local ecosystems (coefficient=0.433, p=0.004) and satisfaction with household economy (coefficient=0.162, p=0.021), but no significant associations were found among women individuals (model 5). Nevertheless, the general consistence of coefficients across regressions suggests that results were robust.

Table 3.4. Associations of subjective well-being and its dimensions against objective measures of capitals among tribal individuals (n=171) from Kodagu (Karnataka, India, 2010).

Explanatory Variables: Objective measures of capitals	Outcome variables			
	Subjective well-being	Satisfaction with dimensions of well-being		
		Subsistence	Security	Reproduction and Care
(1)	(2)	(3)	(4)	
Natural Capital	(a) 0.022 (0.100)	0.077 (0.089)	0.158 (0.093)*	0.256 (0.102)**
Economic Capital	(b) 0.164 (0.114)	0.378 (0.113)***	0.532 (0.116)***	0.176 (0.116)
Schooling	(c) 0.050 (0.085)	0.105 (0.085)	-0.031 (0.084)	0.163 (0.084)*
Age	(d) -0.013 (0.007)*	-0.005 (0.007)	-0.005 (0.007)	-0.004 (0.006)
Male	(e) 0.263 (0.179)	0.023 (0.168)	0.022 (0.175)	-0.023 (0.184)
Illness	(f) -0.513 (0.203)**	-0.392 (0.195)**	-0.516 (0.181)***	-0.031 (0.186)
Scheduled Tribes	(g) 0.591 (0.220)***	0.478 (0.238)**	-0.004 (0.255)	0.240 (0.264)
Outside the forest	(h) 0.597 (0.281)**	0.334 (0.259)	0.165 (0.351)	-0.544 (0.349)

Note: Cells show coefficient estimates of ordered probit regressions and, in parenthesis, the standard errors. Models were run with robust estimator of variance. \*, \*\*, \*\*\* refer to significant levels at 10%, 5%, and 1%, respectively. For definition of variables see Table 3.1 and 3.2.

## Discussion

Our study contributes to the understanding of natural capital as source of satisfiers of human well-being. The main finding of this work is that, for the adivasi and forest dwellers society studied, both natural and economic capital were positively associated with well-being. After discussing some potential biases and caveats of our study, we discuss our main result focussing on two topics. First, we examine the level of life satisfaction among adivasi and forest dwellers, and second, we discuss the associations of both forms of capital to human well-being.

## Caveats and limitations

Results from this study might suffer from some measurement error in the outcome and explanatory variables and from biases related to omitted variables. For instance, although there is consensus in that responses from subjective well-being questions (such as the one used here) are meaningful and reasonably comparable among groups of individuals (Easterlin, 2003), unfamiliarity with these kinds of scales in the studied society might threaten the reliability of the answers. Also, the three dimensions of well-being included in the study overlap to some

Table 3.5. Robustness analysis for overall subjective well-being.

Model	Explanatory variables			
	Subjective measures		Objective measures	
	Natural capital	Economic capital	Natural capital	Economic capital
(1) Core Model	0.258 (0.119)**	0.128 (0.048)***	0.022 (0.100)	0.164 (0.114)
Dropping intentionally control variables:				
(2) Sex	0.248 (0.111)**	0.120 (0.048)**	0.040 (0.099)	0.171 (0.113)
(3) Schedule tribes	0.257 (0.116)**	0.128 (0.048)***	0.068 (0.096)	0.072 (0.105)
(4) Forest location	0.287 (0.115)**	0.107 (0.048)**	0.037 (0.100)	0.216 (0.113)*
Using only part of the sample:				
(5) Only women (n=97)	0.185 (0.111)	0.125 (0.070)*	-0.136 (0.131)	0.040 (0.179)
(6) Only men (n=74)	0.433 (0.151)***	0.162 (0.070)**	0.275 (0.159)*	0.214 (0.134)
(7) Only Schedule tribal individuals (n=142)	0.226 (0.123)*	0.113 (0.051)**	0.029 (0.107)	0.122 (0.121)
(8) Only Individuals living inside forest (n=158)	0.242 (0.117)**	0.124 (0.049)**	0.035 (0.104)	0.117 (0.114)
(9) Using a OLS regression model	0.323 (0.131)**	0.180 (0.068)***	0.014 (0.161)	0.256 (0.183)

Note: Cells show coefficient and, in parenthesis, the standard errors. \*, \*\*, \*\*\* refer to significant levels at 10%, 5%, and 1%, respectively. Core model from columns 1 of Tables 3.3 and 3.4.

degree (Costanza et al., 2007), which may have resulted in some double-counting. We acknowledge that our proxies do not avoid this overlapping and, hence, that we could not evaluate the dimensions one from each other independently. We also might have measurement errors in the objective measures of both capitals, as people might have not remembered or may not have provided accurate information on economic issues and use of natural resources. This might be especially true for some of the proxies of natural capital, since access to forests is highly regulated in the area. Measurement errors in the explanatory variables might produce an attenuation bias and make the estimates more conservative.

Another source of bias in our estimations might come from the role of omitted variables. For instance, variables such as marital status, level of trust, or social capital, are all variables that have been previously associated with individual well-being (Dolan et al., 2008; Easterlin, 2003), but that we did not include in our models. Furthermore, the potential bias from omitted variables might be even greater because omitted variables might have a higher weight on well-being than our variables used in models. Since well-being is affected by many factors, bias by

omitted variables is a common problem in research on well-being. Dolan et al (2008) suggest that a greater understanding of the robustness of relationships could be gained if variables are systematically introduced into different models. Nevertheless, it is important to mention that the types and weights of satisfiers on well-being varies across cultures and historical periods (Costanza et al., 2007; Max-Neef et al., 1993), and hence identifying plausible omitted variables for a given society is a challenging task. We tried to tackle the omitted variable bias by introducing modifications to the core model in our robustness analysis. Results suggested that our estimates were consistent and robust despite several disturbances included in the models.

Last, our study might suffer from two main caveats. First, we might have some double counting, as some assets included as natural capital (e.g. natural resources) might have been included into the values of economic capital (e.g. household income). For instance, we used acres of land and livestock as proxies of natural capital, but both variables might also generate economic capital if agricultural products or milk are commercialized by individuals. In this respect, double counting will depend on how different assets from capitals are considered –as either intermediate or as final services- in relation to their degree of connection to human well-being (Aylward and Barbier, 1992). Researchers have pointed out that double accounting is one of the main problems to address comparisons between natural and economic capital (Aylward and Barbier, 1992; Fisher et al., 2009; Wallace, 2007). The second caveat relates to lack of life-cycle and panel data. We could not control for individual fixed-effects that might affect reports of well-being (Godoy et al., 2009). Some variables might have different associations when using panel data instead of cross-sectional data (Easterlin, 2003; Ferrer-i- Carbonell and Frijters, 2004).

### **Human well-being in Kodagu**

“I am totally unsatisfied with my life. I do not have an appropriated house or job, neither there are basic facilities in the community. The government does not support us enough to improve our living standard, not even regarding the most basic services” told us a 35-year-old lady. Kodagu is often described as one of the districts with highest level of well-being in India (Government of Karnataka, 2006). Paradoxically, life satisfaction scores recorded in our study are lower than the scores obtained in the life satisfaction survey at national level (Veenhoven, 2012). While we found an average score lower than mid-point, life satisfaction scores at national level have are in average higher than the middle point (Veenhoven, 2012). We argue that this finding might be explained by the fact that our sample consisted of informants from

adivasi and forest dwellers, a population that has historically suffered marginalization in the Indian society. An additional explanation to that finding relates to the local definition of well-being. In our previous work we saw that one of the main problems on public policies on well-being seems to be the gap between indicators used by government and local satisfiers of well-being. It seems that public policies are not assessing the local definition of well-being among people from Kodagu (Chapter 1).

Despite the low overall level of well-being, we also found that two of the three dimensions of well-being included in this study showed a level of satisfaction higher than mid-point. The relative satisfaction of subsistence and reproduction and care may be explained by some particular programs carried out by the government that seems to be running well. People explained that they are relatively satisfied with the public distribution system of food and education. Particularly, where people can get scholarships to attend the school, people reported high levels of satisfaction towards children education. Previous ethnographic information evidenced that Kodagu's network of primary schools covers a large number of adivasi colonies (Dempsey et al., 2012). Nevertheless, results suggest that there is a lack of association between overall well-being and the three dimensions. Since well-being is a multidimensional construct -where particularly HSD proposes eleven dimensions-, there might be dimensions not included in our study that could explain the low overall life satisfaction found among forest dwellers. This finding has practical implications because it invites both researchers and policy-makers to look for the dimensions with most weight on well-being.

### **How does natural capital affect subjective well-being?**

We found that the association between subjective well-being and our measure of satisfaction with ecosystems was stronger than the association with our measure of satisfaction with household economy. We explain the large association of satisfaction with the ecosystems and subjective well-being because of the direct dependence of the studied society with the ecosystems. Although all human societies ultimately depend on natural systems for their subsistence (Gómez-Baggethun and de Groot, 2010), this link might be more evident for societies –like the one studied here- with an economy directly based on natural resources. “Coffee and pepper are the main sources of my income” stated one of the informants. Nevertheless, beyond the clear economic dependence on natural capital for income, people in the sample also valued other aspects of the ecosystems around them, for example to ensure household production of food. “We have land, but it is not enough to satisfy all our food requirements” argued a woman living inside forest and who reported a mid-point level of life

satisfaction, implying that they also needed the forest to make a living. The surrounding environments also “offer calm and peace to us, so I prefer to live close to the forest” emphasized a 27-years-old man. Furthermore, ecosystems also have religious values for local people, as witnessed by the presence of several sacred forests around Kodagu (Bhagwat et al., 2005; Ormsby, 2011). This finding dovetails with our previous research in the area, where we found that ecological assets are perceived locally as major satisfiers of human well-being (Chapter 1).

Based on our findings, we emphasize that natural capital is key to fulfil human well-being, specially in rural and indigenous contexts. But, how to approach an assessment of natural capital into of public policies on well-being? For the case of Kodagu, our previous works give a list of ecosystem assets which could be suitable elements to include into policy measures on well-being (chapters 1 and 2). Nevertheless, as we describe above, few ecological assets have been examined in the literature on well-being indicators (Dolan et al., 2008; Helliwell et al., 2012) and this is one of the main gaps for approaching successful policy measures (Costanza et al., 2007; Dolan et al., 2008). It is important to emphasize that although natural capital plays a key role in every society and at different scales, its weigh of contribution on well-being might differ across societies and scales in comparison to other capitals. In fact, Hein et al. (2006) point out that valuation of ecosystem services varies across stakeholders and special scales. Hence, as Kontogianni et al (2010) emphasize, it is likely that the role of different forms of capital on human well-being will be context specific rather than broadly applicable across cultures and geographical regions.

Our most noteworthy finding relate to the associations of natural and economic capital with the three dimensions of well-being addressed. Our results suggest that the role of natural and economic capital differ significantly across dimensions of well-being. We think that the strict control on the access to natural resources by Indian regulation might explain our finding about higher association of subsistence dimension with economic capital than with natural capital. Due to of the strict control on the access to natural resources, the economic capital might become an important source of satisfiers to meet the subsistence dimension. Our finding about significant associations of both types of capital with satisfaction of security dimension might suggest there is a balance in the way the locals rely on both types of capitals to cope with livelihood insecurity (i.e. temporary and uncertain wages, inability to save money, and lack of cash). Association between natural capital and the dimension reproduction and care suggests that people might conceive ecosystems as a main source of ‘good living’ for the

future of their Children. As a 22-year-old woman said: “forest allows to satisfy not only our needs but also the needs of next generations“. Last, we also found that associations using subjective and objective measures of capitals differed each other. This could be explained by the fact that the level of satisfaction does not have relation with objective quantities of each form of capital. This is, satisfaction is reached at different magnitudes of objective measures across individuals. Therefore, our finding suggests that objective factors do not always have direct effects on well-being and that it is important how these factors are perceived.

## Conclusions

Natural capital matters on human well-being. Furthermore, among rural and indigenous societies natural capital can have a larger importance than economic capital in satisfying particular well-being dimensions. In this study we detail particular ecological assets that could be conceived as satisfiers of well-being and its dimensions. Nevertheless, associations between natural and economic capital and human well-being depend on which measure of capital (either subjective or objective) is used in the model. According to our results, individual satisfaction with local ecosystems has a greater importance than objective magnitudes associated to each form of capital.

Our research also gives worrying results regarding the human well-being among forest dwellers from Kodagu. We think that the mid-point of well-being reported by people must be a concern issue for the local government. Nevertheless, we could also suppose that, since nowadays people from Kodagu is receiving land rights (Macura et al., 2011) and hence gradually more access to natural capital, forest dwellers could face an increase in their well-being. This is an important issue to keep in mind when designing well-being policies at the study area.

We conclude by outlining two policy suggestions. First, our results highlight the importance of including natural capital in policies related to well-being and of recognizing natural capital as a main source of satisfiers. Plausible lists of satisfiers to focus policies measures are given by previous works in the area (Chapters 1 and 2). Second, since natural and economic capital play a different role as sources of satisfiers across dimensions, our study gives insights for possible strategies on how to complement natural and economic capital assets when designing policies to improve particular dimensions of well-being.

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## **Discusión general**

La discusión general está estructurada en tres secciones. La primera sección describe las contribuciones y limitaciones metodológicas del trabajo de investigación. La segunda sección discute las principales contribuciones teóricas de la Tesis doctoral. La última sección desarrolla sugerencias hacia políticas públicas sobre bienestar humano y manejo de ecosistemas del distrito de Kodagu.

### **Contribuciones y limitaciones metodológicas**

La Tesis doctoral brinda dos principales contribuciones metodológicas que podrían ser retomadas en investigaciones futuras. La primera contribución metodológica se refiere a la tan nombrada complementación entre metodologías de tipo cualitativo y metodologías de tipo cuantitativo. Debido a que la definición de bienestar humano y las percepciones de los ecosistemas cambian según los contextos culturales y geográficos, y según los periodos históricos (Alkire, 2002; Cruz et al., 2009; Max-Neef et al., 1993; Millennium Ecosystem Assessment, 2003; Rawls, 1999), el estudio de la contribución del capital natural al bienestar humano, enfrenta el reto de diseñar una metodología que no se base en el supuesto de idoneidad de los indicadores provenientes de otras culturas y lugares. Al contrario, el desafío metodológico es evaluar los conceptos de capital natural y bienestar en base a indicadores identificados localmente (Folke et al., 2005; Hagerty et al., 2001; Malkina-Pykh and Pykh, 2008; Max-Neef et al., 1993; Millennium Ecosystem Assessment, 2003; Sirgy, 2011; Swain and Hollar, 2003). Con el objetivo de capturar estos indicadores locales, esta Tesis utilizó la teoría del consenso cultural como marco teórico para diseñar la estrategia metodológica cualitativa. A través de esta estrategia metodológica se logró identificar un conjunto de indicadores de bienestar y capital natural, que pudieron posteriormente ser utilizados para estimar cuantitativamente los niveles de bienestar y aprovechamiento del capital natural. Por tanto, una primera contribución metodológica de la Tesis consiste en proporcionar un ejemplo práctico y concreto de cómo las metodologías cuantitativa y cualitativa pueden combinarse.

La segunda contribución metodológica de esta Tesis está relacionada con la estrategia de evaluación del bienestar. La mayoría de trabajos empíricos sobre la relación entre bienestar humano y capital natural ha utilizado un único índice de bienestar general (e.g. índice satisfacción de vida o felicidad) (Easterlin, 2001; Easterlin, 2003; Easterlin et al., 2010; Ferrer-i-Carbonell, 2005; Ferrer-i-Carbonell and Gowdy, 2007; Layard, 2010; Vemuri and Costanza,

2006). Esta Tesis presenta una innovación metodológica al diferenciar entre tres dimensiones diferentes del bienestar humano: subsistencia, seguridad, y reproducción y cuidado. Basándome en los resultados obtenidos al aplicar la metodología cualitativa, identifiqué un conjunto de indicadores asociados a cada una de las tres dimensiones incluidas en el estudio. Los resultados sugieren que los diferentes indicadores de capital económico y natural muestran asociaciones diferentes con cada una de las dimensiones de bienestar, sugiriendo la necesidad de usar esta estrategia metodológica (i.e., diferenciar entre diferentes dimensiones de bienestar) en trabajos futuros.

Además de algunas limitaciones metodológicas que han sido discutidas en los diferentes capítulos de esta Tesis, el trabajo presentado aquí tiene otras dos limitaciones que no han sido mencionadas anteriormente. La primera limitación metodológica tiene que ver con la interpretación de datos individuales como representantes del colectivo. La metodología utilizada aquí asume que la suma de respuestas individuales representa la visión del grupo (entendido tanto como comunidad o como región). Por ejemplo, la metodología usada en el capítulo 1 para capturar información sobre el bienestar humano se basa en la teoría del consenso cultural. Bajo este marco metodológico, se recogen datos entre individuos de un grupo social para generar una lista de elementos definidos por la gente local como aspectos importantes para el bienestar humano, nombrados en la Tesis como medios locales. Esta estrategia metodológica asume que los medios locales nombrados de forma independiente por diferentes individuos encuestados son los medios que caracterizan el bienestar local del grupo (Puri, 2011). Sin embargo, es posible que la importancia de estos medios locales responda a percepciones grupales más que a percepciones individuales. Esto es, las ponderaciones y valoraciones de los medios locales del bienestar pueden ser distintas cuando se agrupan las respuestas de diferentes individuos que cuando se toma al grupo como un todo (Costanza et al., 2007). Si esto es así, entonces las listas elaboradas sólo representarían percepciones individuales y la representatividad de los resultados obtenidos para los niveles grupales o regionales sería limitada.

La segunda limitación metodológica de esta Tesis se relaciona a los cambios que potencialmente ocurren a través del tiempo en relación tanto a cómo la gente percibe el bienestar humano como a cómo se percibe y usa el capital natural. Los medios locales, los servicios ecosistémicos, y las relaciones entre bienestar humano y capital natural son conceptos dinámicos que pueden cambiar en el tiempo (Costanza et al., 2007; Easterlin, 2003; Ferrer-i-Carbonell and Frijters, 2004; Godoy et al., 2009; Hagerty et al., 2001). Como señalé en

la discusión del tercer capítulo, en el futuro se deberían realizar investigaciones de tipo panel, que abordaran el análisis de datos capturados durante un largo periodo de tiempo más que en tiempos puntuales. Por ejemplo, puesto que esta Tesis proporciona información que se enmarca en un periodo de tiempo puntual, futuras investigaciones en la región podrían tomar estos resultados como línea de base para construir un análisis temporal. Más aún, ya que los datos fueron tomados en un momento histórico marcado por importantes cambios en el uso de los recursos naturales debido a la implementación de la nueva reforma de derechos de tribales (Macura et al., 2011), investigaciones futuras podrían comparar el efecto de esta reforma sobre aspectos de bienestar, servicios ecosistémicos, y sus relaciones.

### **Contribuciones teóricas**

La más importante contribución teórica de esta Tesis es que, en su conjunto, contribuye a entender mejor las relaciones entre bienestar humano y capital natural. Entender estas relaciones es importante ya que realza la contribución de otros tipos de capital, no sólo el económico, en la generación de bienestar. Puesto que no es posible invertir directamente en las necesidades humanas, las investigaciones y políticas públicas en bienestar deben orientarse a crear las oportunidades para que la gente pueda satisfacer sus necesidades (Cruz et al., 2009; Max-Neef et al., 1993). La creación de oportunidades se puede estimular a través de la inversión en los capitales natural, económico, humano, y social. En este sentido, entender la aportación de los diferentes tipos de capitales a la satisfacción del bienestar humano y sus dimensiones debería ser un aspecto fundamental en el diseño de políticas públicas de desarrollo humano (Costanza et al., 2007; Cruz et al., 2009; Max-Neef et al., 1993).

En base a muestras aleatorias y a metodologías independientes, los tres artículos presentados en esta Tesis sugieren que hay una relación directa y significativa entre el capital natural al que las personas tienen acceso y su bienestar. Por ejemplo, las personas de Kodagu listan bienes y servicios ambientales como elementos importantes para su bienestar. Asimismo, al describir los ecosistemas locales, las personas se refieren a aquellos servicios vinculados al sustento del hogar como servicios de importancia básica. De forma similar, los ecosistemas locales son percibidos como fuentes de múltiples servicios, incluyendo servicios culturales y espirituales, y no sólo como fuente de provisión de recursos naturales. Los análisis cuantitativos también sugieren que el bienestar humano y el capital natural tienen una relación positiva y significativa, y que estas relaciones cambian para las diferentes dimensiones de bienestar analizadas.

La Tesis haya resultados interesantes en relación a la diversidad de satisfactores implicados en el bienestar local. A diferencia de los instrumentos de evaluación de políticas públicas, las poblaciones locales no sólo destacan los indicadores económicos sino que también incluyen otros medios relacionados con salud, nutrición, ambiente y religión como aspectos clave en su bienestar. Los resultados hallados en esta Tesis convergen con investigaciones previas que sugieren que el bienestar se consigue mediante diversos satisfactores y no sólo mediante satisfactores económicos como ha sido el supuesto normativo en la literatura de bienestar humano (Dolan et al., 2008; Easterlin, 2003; Masferrer-Dodas et al., in press; Max-Neef et al., 1993).

A nivel teórico, esta Tesis también proporciona importantes avances en el conocimiento de las relaciones entre sociedades rurales y ecosistemas locales. Por ejemplo, los resultados presentados aquí sugieren que los individuos más jóvenes, con mayor riqueza, y con más educación son capaces de reconocer un mayor número de servicios ecosistémicos que las personas sin esas características. Estos resultados ayudan a entender cómo las percepciones sobre servicios ecosistémicos varían dentro de un determinado grupo social, un resultado que tiene importantes implicaciones a la hora de plantear políticas públicas. Además, los resultados coinciden con otras investigaciones en el tema que describen que los servicios ecosistémicos de provisión son a menudo los más valorados por la gente local (Pereira et al., 2005; Rodríguez et al., 2006).

Los resultados de la Tesis también sugieren que la contribución del capital natural al bienestar humano es tan importante como la contribución del capital económico, la medida estándar de bienestar humano, al menos entre la población de estudio. Este resultado es interesante puesto que apoya la sostenibilidad ambiental como vía de desarrollo, frente al crecimiento económico enfatizado por la principal corriente de pensamiento en temas de bienestar humano (Easterlin, 2003; Ferrer-i-Carbonell, 2005; Ferrer-i-Carbonell and Gowdy, 2007; Layard, 2010; Masferrer-Dodas et al., in press; Max-Neef, 1995). Más interesante aún es el resultado de que ambos capitales, el económico y el natural, se relacionan de forma distinta con dimensiones diferentes del bienestar humano. Por ejemplo, en el caso de Kodagu, los resultados sugieren que capital natural contribuye de forma significativa a la satisfacción de la dimensión de reproducción y cuidado, mientras que, por su parte, el capital económico contribuye a la satisfacción de la dimensión de subsistencia. Y ambos capitales parecen contribuir de forma similar a la satisfacción de la dimensión que tiene que ver con la seguridad.

Por último, el caso de Kodagu representa otro ejemplo interesante en la paradoja en las relaciones entre crecimiento económico y bienestar humano (Easterlin, 2003; Easterlin et al., 2010; Max-Neef, 1995). El capítulo 3 de la Tesis demuestra que a pesar de que Kodagu es descrito como uno de los distritos con más alto nivel de bienestar económico en India (Government of Karnataka, 2006), los índices de bienestar registrados en este trabajo para Kodagu son menores al promedio nacional (Veenhoven, 2012). Una posible explicación para este hallazgo es que el grupo social estudiado en el capítulo 3, compuesto por individuos adivasi y habitantes del bosque, ha sufrido históricamente una marginalización en la sociedad india, y es esperable entonces que sus índices de bienestar sean menores al promedio de la población total. Estos resultados sugieren que las políticas públicas asociadas al mejoramiento del bienestar en este grupo social han sido insuficientes o poco exitosas. De hecho, como se demuestra en el capítulo 1, uno de los principales problemas en las políticas públicas sobre bienestar parece ser la brecha entre los indicadores usados por los gobiernos y los satisfactores de bienestar identificados por la población local.

### **Contribuciones en política pública**

En su conjunto, la Tesis doctoral también hace sugerencias que podrían ser retomadas en términos de las políticas públicas relacionadas con el bienestar y la gestión ambiental. Por ejemplo, tal y como se explica en el capítulo 1, existe una enorme brecha entre la definición local de bienestar y cómo los gobiernos conceptualizan y evalúan este concepto dentro de los instrumentos de gestión. Los resultados presentados aquí sugieren que las políticas públicas no consiguen capturar todos los elementos que las poblaciones locales consideran importantes en el mantenimiento de su bienestar. El instrumento para evaluar el bienestar no captura indicadores que representan el concepto de bienestar a nivel local, sino que para la evaluación utiliza indicadores identificados en instancias diferentes a las locales (i.e. adopta indicadores foráneos). De igual modo, la gente local –tal vez por desconocimiento o por características culturales intrínsecas- parece no ser consciente de la importancia que pueden tener en su bienestar algunos elementos que sí se valoran en las políticas públicas (e.g. igualdad de género, trabajo infantil). Ya que el equilibrio entre los indicadores utilizados por los políticos y los indicadores indicados por la gente son clave para el éxito de políticas públicas sobre bienestar (Costanza et al., 2007; Hagerty et al., 2001; Malkina-Pykh and Pykh, 2008; Swain and Hollar, 2003), la Tesis enfatiza la importancia de incluir indicadores locales en los instrumentos de bienestar humano aplicados en Kodagu.

El capítulo 2 también presenta sugerencias prácticas sobre las relaciones entre población y ecosistemas locales. Los resultados del capítulo 2 dan una lista de servicios ecosistémicos que podrían ayudar a focalizar las decisiones políticas sobre el manejo de los ecosistemas locales. Además, los resultados demuestran que las percepciones de los ecosistemas y la forma cómo estos son usados difieren de un grupo social a otro, sugiriendo que las decisiones políticas sobre el manejo ecosistémico podrían tener efectos diferentes de un individuo o grupo social a otro.

Por último, los resultados del tercer capítulo hacen tres contribuciones importantes a políticas públicas. Primero, ya que los resultados obtenidos en esta Tesis sugieren que el promedio de bienestar humano entre individuos adivasi y habitantes del bosque está por debajo el promedio nacional, parece urgente la necesidad de reenfocar políticas públicas hacia este grupo social a fin de aumentar su nivel de bienestar. Segundo, los análisis cuantitativos sugieren que el bienestar local no sólo depende del capital económico, sino que el capital natural también juega un papel importante en conseguir el bienestar, y por tanto debe ser incluido dentro de los instrumentos relacionados con la mejora del bienestar. Tercero, y último, los resultados sugieren que el papel del capital natural y económico varía entre cada una de las tres dimensiones del bienestar analizadas en el estudio. Este resultado contribuye a orientar las políticas públicas (i.e. hacia capital natural, capital económico, o ambos) para aumentar las oportunidades de satisfacción de determinadas dimensiones del bienestar.

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## **Conclusions**

I end this doctoral dissertation by outlining the main conclusions of three chapters presented here.

Chapter 1 highlights the need to achieve a balance between top-down and bottom-up approaches in the selection of indicators to elaborate policies related to human well-being. I emphasize the importance to incorporate into public policies those satisfiers or local means, in the language of this Thesis, defined by local people. The definition of public policies is heavily influenced by economic development thinking and public policies typically approach the well-being indicators guided by the interest of improving socioeconomic development based on economic indicators. In this context, the first conclusion in chapter 1 is that people recognize a diverse set of material and non-material elements, both manufactured and natural, as means to fulfil their well-being. These means do not only come from the economy, but also from ecosystems, social relationships, knowledge, and politics, and therefore can not be properly measured using only economic indicators. The second important conclusion of that chapter is that there is an important gap between the current indicators of well-being considered in public policies and the means of well-being defined by people.

Results from Chapter 2 suggest that ecosystems are locally perceived as a source of multiple goods and services that go beyond the production of food (for subsistence or for cash). Although one of the main services described by people is the production of food for self-consumption and commercialization, a service that is closely linked to household livelihood, local people also perceive a myriad of material and non-material services and values provided by local ecosystems. Results from multivariate regressions suggest that younger, wealthier, and more formally educated individuals perceive more ecosystem services than people without those characteristics. Also, people from different cultural backgrounds have different perceptions from local ecosystems services. This finding is important because suggest that ecosystem services are perceived in different ways by people with different socio-economic characteristics.

Chapter 3 illustrates that natural capital contributes in a positive and significant way to human well-being. Furthermore, results from that chapter suggest that natural capital can have a greater importance than economic capital in satisfying needs of particular well-being dimensions among individuals from rural and indigenous societies. In this chapter, I provide detail of particular ecological assets that are perceived locally as important satisfiers of well-

being. My research also gives worrying results regarding the actual level of well-being among adivasi and forest dwellers people from Kodagu, as in average indicators of life satisfaction are around the mid-point of the scale uses, an aspect that should be of concern for the local government. As in the last years, people from Kodagu have received some land rights, and hence potentially have more access to natural capital, adivasi and forest dwellers could face an increase in their well-being. This is an important issue to keep in mind when designing well-being policies at the study area.

I would like to finish this work by outlining some policy suggestions. First, this doctoral dissertation provides relevant insights for a set of plausible indicators that, according to local perception, matter for local well-being. Public policies oriented to improve those indicators would also help achieve a well balance between top-down and bottom-up approaches for local public policies oriented to improve well-being. Second, since according to the results presented here local ecosystems have social relevance –in addition to its already recognized biological relevance- management policies of those ecosystems should assure a sustainable access to the goods and services they generate or should compensate for the lack of it. Our study brings a list of ecosystem goods and services that matter for local well-being and that would help focus policy decisions in the area. Third, since perceptions and uses of ecosystems differ across social groups, policies should take into account that any decision on ecosystem management would have dissimilar effects across social groups, an aspect often neglected by policy makers, or unaddressed due to lack of resources for more targeted policies. Fourth, our results also highlight the importance of including natural capital in policies related to well-being and of recognizing ecosystems as a main source of satisfiers. Plausible lists of satisfiers in which policies could focus are given in the two first chapters of the doctoral dissertation. Last, since natural and economic capital play a different role as sources of satisfiers across dimensions, my results give insights for possible strategies on how to complement natural and economic capital assets when designing policies to improve particular dimensions of well-being. The latter conclusion supports the ecological economics Thesis on ‘strong sustainability’, that suggests the necessity to preserve natural capital as a distinct capital stock that in case of being lost or degraded may non be substituted by economic capital.

## Anexo I:

### **Colaboración institucional y Redes de co-autorías durante el trabajo de Tesis doctoral**

Esta Tesis doctoral fue un trabajo de colaboración entre el Laboratorio de Etnoecología del Institut de Ciència i Tecnologia Ambientals de la Universitat Autònoma de Barcelona (España) y el French Institute of Pondicherry (India). La investigación se ha desarrollado en el marco de los proyectos de investigación “*How is local ecological knowledge transmitted? An exploratory research among the Soligas, India*” (2007-2009), otorgado a la Dra. Victoria Reyes-García bajo el financiamiento de NSF- Cultural Anthropology Program (BSC-0726612), y “*Public Policies and Traditional Management of Trees and Forests –POPULAR*” (2007-2010), dirigido en India por el Dr. Claude García y financiado por el ANR-French National Research Agency Project (ANR-05-PADD-0XX) (más información en: [www.ifpindia.org/Biodiversity-and-Tree-Ownership-Rights,401.html](http://www.ifpindia.org/Biodiversity-and-Tree-Ownership-Rights,401.html)). Parte de la Tesis doctoral también fue desarrollada en colaboración con el Dr. Rajindra K. Puri, del School of Anthropology and Conservation, University of Kent (Inglaterra).

La productividad científica de esta colaboración institucional ha sido alta. Además de los capítulos presentados en esta Tesis, de los cuales uno ya está publicado, se han elaborado otros tres artículos científicos. Los artículos también analizaron aspectos de la relación entre ecosistemas y personas de Kodagu. En los artículos científicos, soy parte de los coautores. El primer artículo, titulado “*Local Community Attitudes toward Forests Outside Protected Areas in India. Impact of Legal Awareness, Trust, and Participation*” analiza si las actitudes de gente local hacia los bosques reservados están influenciadas por el grado de conocimiento de la nueva reforma de derechos del bosque y las relaciones locales con el Departamento Forestal de Karnataka. Este artículo fue publicado en *Ecology and Society*. El segundo artículo, “*The Selective Persistence of Local Ecological Knowledge: Honey Collecting with the Jenu Kuruba in South India*”, describe el conocimiento ecológico local de la recolección de miel en la comunidad Jenu-Kuruba, y ha sido publicado en *Human Ecology*. Por último, el tercer artículo publicado se titula “*Social learning across the life cycle: cultural knowledge acquisition for honey collection among the Jenu Kuruba, India*”, y analiza los patrones de aprendizaje social para el caso del conocimiento ecológico tradicional de recolección de la miel en la comunidad Jenu-Kuruba. Este último artículo fue publicado en la revista *Evolution and Human Behavior*.

Los dos últimos artículos han sido parte de la Tesis de doctorado en Antropología de Kathryn Demps (University of California, at Davis). Las referencias completas de estos artículos son:

Macura, B., Zorondo-Rodríguez, F., Grau-Satorras, M., Demps, K., Laval, M., García, C.A., Reyes-García, V., 2011. Local Community Attitudes toward Forests Outside Protected Areas in India. Impact of Legal Awareness, Trust, and Participation. *Ecology and Society* 16.

Demps, K., Zorondo-Rodríguez, F., García, C., Reyes-García, V., 2012. The selective persistence of local ecological knowledge: honey collecting with the Jenu Kuruba in South India. *Human Ecology* DOI: 10.1007/s10745-012-9489-0.

Demps, K., Zorondo-Rodríguez, F., García, C., Reyes-García, V., 2012. Social learning across the life cycle: cultural knowledge acquisition for honey collection among the Jenu Kuruba, India. *Evolution and Human Behavior*, DOI:10.1016/j.evolhumbehav.2011.1012.1008.

## **Anexo II:**

### **Imágenes de Kodagu, su gente, y recursos naturales**

#### **Paisaje de Kodagu**



Figura anexo 2.1 Paisaje de Kodagu (Karnataka, India): cultivos de café bajo sombra de bosque.



Figura anexo 2.2 cultivos de arroz en Kodagu, (Karnataka, India).

#### **Comunidades Adivasi**



Figura anexo 2.3. Comunidad Adivasi en borde de bosque en Kodagu (Karnataka, India).



Figura anexo 2.4 Comunidad adivasi en borde de bosque en Kodagu (Karnataka, India).



Figura anexo 2.5 Casa de comunidad adivasi en borde de bosque en Kodagu (Karnataka, India).



Figura anexo 2.6. Casa destruida en comunidad adivasi en borde de bosque en Kodagu (Karnataka, India).



Figura anexo 2.7 Comunidad Adivasi en interior de bosque en Kodagu (Karnataka, India).



Figura anexo 2.8 Casa de comunidad adivasi en interior de bosque en Kodagu (Karnataka, India).



Figura anexo 2.9 Casa de comunidad adivasi en interior de bosque en Kodagu (Karnataka, India).



## Infraestructura de servicios básicos



Figura anexo 2.10 Infraestructura para aprovechamiento de agua en Kodagu (Karnataka, India).



Figura anexo 2.11 Infraestructura para aprovechamiento de agua en Kodagu (Karnataka, India).



Figura anexo 2.12 Infraestructura de electricidad solar (sin funcionamiento) en Kodagu (Karnataka, India).



Figura anexo 2.13 Infraestructura de electricidad solar (sin funcionamiento) en Kodagu (Karnataka, India).

## Recursos naturales aprovechados por gente local



Figura Anexo 2.14 Material arbóreo para confección de productos de aseo



Figura Anexo 2.15 Fruto "sikekay" en Large Scale Adivasi Multi-Purpose Societies (LAMPS).

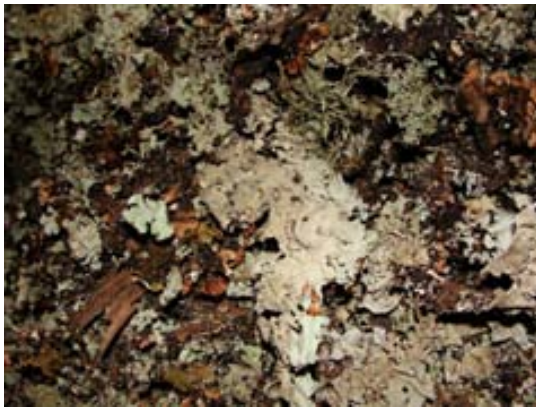


Figura Anexo 2.16 Líquenes en Large Scale Adivasi Multi-Purpose Societies (LAMPS) de Kodagu (Karnataka, India).



Figura Anexo 2.17 Extracción de rocas en Kodagu (Karnataka, India).



Figura Anexo 2.18 Fruto de *Sapindus sp.* de bosques de Kodagu (Karnataka, India).



Figura Anexo 2.19 Fruto de *Sapindus sp.* en Large Scale Adivasi Multi-Purpose Societies (LAMPS) de Kodagu (Karnataka, India).



Figura Anexo 2.20 Leña recolectada en bosques de Kodagu (Karnataka, India).



Figura Anexo 2.21 Cultivos por comunidades adivasi en Kodagu (Karnataka, India).

