Natural and Social Capital Valuation:
Piloting a Bottom-Up Approach to Valuing Rural Land and
Exploring the Potential for Computer Assisted Mass Appraisal

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Abstract

Billions of people live in rural areas and rely on natural resources for their livelihoods. People with strong reliance on the commons in India, the country featured in our case study, typically have insecure land tenure rights but derive major livelihoods benefits from communally managed resources. Yet there is often limited understanding of the economic value of that land. The dearth of information on rural assets leaves communities and individuals vulnerable to speculation and limited compensation if land is diverted for other uses, as well as missed opportunities to fully benefit from natural and social capital even when they continue to manage it.

Equipping rural households, the investment community, and governments with a tool to estimate the economic value of the broad range of assets held and used on rural lands can help reduce information asymmetry and empower rural residents to negotiate from a stronger position, thereby reducing conflicts and improving investment outcomes. It can also help rural residents better understand their relationship with the land they use and improve the outcomes of natural resource management decision-making. Unfortunately, existing valuation methods for commercial use of land and forests do not consider the full range of values generated by assets important to rural livelihoods.

A rural land valuation tool can enhance appreciation of the value generated by land and the role that social institutions play to enhance that value. This paper presents a new mobile tool to value rural land based on bottom-up engagement, developed together by an international forestry valuation firm, a leading Indian NGO, and a university department specialized in real estate valuation. The tool integrates social capital as a proxy for tenure security in areas with unclear property rights. Discussion of the bottom-up tool includes learnings from field-testing in Rajasthan, India across forest and grassland ecosystems with varying land uses and tenure security, with a focus on the commons. It also includes an assessment of the potential role of GIS, remote sensing, and computer-assisted mass appraisal in scaling up use of the tool.

Initial field testing was completed at the end of 2016. Initial findings will be shared with conference participants. Significant value is derived from the surveyed commons in the form of fodder and other non-timber forest products, water, and spiritual value. In employing the tool’s social capital survey, distinctions have been observed between the value generated in managed and unmanaged commons.

Key Words: natural capital, social capital, valuation, land tenure, commons
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Chapter 1: Introduction

Millions of people live in rural areas and rely on natural resources for their livelihoods. While land provides individuals and communities with income, shelter, food, as well as intangible services, there is often little understanding of the economic value associated with these services. The dearth of information on rural assets often leaves individuals and communities vulnerable to speculation and missed opportunities to benefit from their natural capital. When faced with outside interest in their lands or resources, rural residents may find themselves ill equipped to negotiate fair compensation.

In recent years, land disputes between local communities and large-scale investors in developing countries have drawn considerable public attention. The Rights and Resources Initiative and the Tata Institute of Social Sciences tracked 289 ongoing land conflicts in India between January and September 2016 alone, estimated to capture only 25-40 percent of the total number of land conflicts in the country. Three quarters of these land-related conflicts involved common lands. Over 40 percent of all land-related conflicts involved forest lands, the majority of which occurred in regions where the state had failed to recognize the customary rights of tribal communities.

Land disputes often emerge from misunderstandings and power struggles between government, industry, and communities, as well as within communities. From the perspective of government and private sector, land is often seen as a source of revenue. They may see opposition from communities as violating statutory rights in situations where community land tenure is weak or unclear to begin with. At the same time, companies and governments incur risks by underestimating the value of community assets. Particularly within rural contexts, land prices are often hard to obtain and often do not represent the value of land well. This is increasingly a concern as the area of land and natural resources under commercial investment continues to grow.

Rural Valuation Tool

In response to these conditions, Indufor, together with the Foundation for Ecological Security (FES) and the University of Ulster, developed an innovative approach to evaluating land with support from Omidyar Network. The bottom-up land valuation tool can be used by individuals, communities, NGOs, or cooperatives to measure the value that people derive from a specific land parcel, and measure the level of tenure security over that land parcel. The tool is especially suited for valuing land that does not yet have a clear market value, is extralegal in tenure status, and/or is heavy on nonmarket assets. Equipping rural residents, the investment community, and governments with a tool to ascertain economic values across a broad range of assets held and used by rural residents can help reduce information asymmetry and empower...
residents to negotiate from a stronger position, thereby reducing conflicts and improving investment outcomes. The tool aims to:

- Illustrate a benchmark of the wide range of benefits (in monetary terms) that individuals and communities obtain from their land. This could be used as an advocacy tool, for example for greater devolution of rights to communities either through leasehold arrangements or additional reforms.
- Empower rural residents with access to information and create incentives to improve stewardship.
- Help communicate the winners and losers associated with different land use scenarios (i.e. different levels of tenure security, social capital, and natural capital conservation).
- Place an estimated value on the costs that would have to be incurred to restore the benefits and services derived from “the commons” in the event access to such lands were to be extinguished.
- Help understand the relationships among rural residents and facilitate intra-community negotiations over land use and related benefits.

Unlike traditional valuation approaches, the Rural Valuation Tool does not try to place a market value on land based on a conventional set of real estate indicators. Instead, the tool captures a more diverse set of values to better estimate the value that rural residents derive from their lands. Using historical data collected through focal group meetings with communities, the tool populates a discounted cash flow (DCF) model that performs a cost-benefit analysis to calculate net benefits derived from natural capital projected over a 15-year period, with the discount rate informed by the level of social capital and tenure security related to the parcel in question. It currently covers tangible values derived from harvesting of forest products, agriculture, grazing, mining, and water use, as well as intangible services such as spiritual or recreational values. The rate used to discount cash flows draws from both a social capital rating and country-specific investment risk.

Initial piloting of the tool has resulted in valuations of six commons used by six villages in Rajasthan, working together with FES, which has decades of experience working throughout rural India.

The following chapters will provide an overview of relevant valuation methods (Chapter 2), a description of the developed Rural Valuation Tool (Chapter 3), discussion of the role of GIS, remote sensing, and computer-assisted mass appraisal in scaling up use of the tool (Chapter 4), d) learnings from piloting the tool in Rajasthan (Chapter 5); and e) outlook for the tool going forward, relevant for new prospective users of the tool (Chapter 6).
Chapter 2: Land Valuation Primer

For rural residents, land is an aggregation of natural capital that provides them with tangible benefits such as income, shelter, and food, as well as intangible benefits such as spiritual or recreational value.

Some level of social capital is associated with individual or community capacity to steward that land sustainably, based on a combination of tenure security, institutional capacity, and community cohesion. Assets expected to be used for more than 12 months are deemed long-term assets under the International Financial Reporting Standards. Identifying land used by communities that is often managed for decades as a long-term asset can help provide incentives for sustainable land management and strengthen land tenure security.

Ideally, this broader set of natural and social capital can be incorporated into land valuation, beyond the scope of traditional land valuation methods, to measure how much benefits rural residents can derive from the land. Trying to put a monetary value pose more challenges in rural emerging markets and the valuation scope. Major challenges include:

- Limited land market information in rural areas
- Misalignment between de facto land use and legal land use classification
- Land tenure insecurity, frequent misalignment between land occupants and rights holder
- Difficulties of quantifying intangible benefits

Traditional Land Valuation Approaches

Where land markets are relatively active in transacting ownership and use rights in land, a number of mainstream valuation methods can be used to estimate value based on market signals. Conventional market-based methods include:

- **Comparable sales approach**: Uses land sales data as a benchmark for the land being valued, ideally based upon analysis of all relevant recent transactions in the vicinity. It adjusts comparable variables to reflect the characteristics of the target land parcel. Despite some standardized scientific guidance, this method relies considerably on intuition drawn from appraiser’s skills and experience. It works best in mature markets, where good market and comparable transactions data are available.

- **Profit approach**: Ideally suited to the valuation of commercial land or buildings that have active business activities, but where data on comparable sales or rental transactions are not available.
Based on an assessment of receipts and expenditures of the business, the method can establish its fair maintainable trade, which allows the identification of net profit capitalized to identify value.

- **Income approach**: Based on an assessment of net income over a given time period. The approach can adopt a traditional income capitalization approach or a contemporary discounted cash flow approach, utilizing a discount rate related to a combination of risks taken and alternative investment opportunity rates. The approach relies heavily on the ability to assess net income/cash flows, highly sensitive to the discount rate.

- **Replacement cost approach**: Approximates value by estimating the cost it would take to provide an alternative, with some deductions made based on issues of age or function, where the structure being assessed is not new or perfectly functioning. This depreciated replacement cost is then added to the land value in its current use and an additional sum to represent the time and risk involved in providing the alternative asset. This method is mainly used to value buildings or other improvements to land where other methods are applicable.

**What is Natural Capital?**

Although definitions vary, natural capital is commonly thought to encompass the aggregate assets or stocks that provide both natural resources and environmental services. A growing consensus in the recognition of natural capital reflects a shift from only focusing on tradable natural resources to a broader concept of environmental services. Freeman outlines five major services produced by a “natural resource-environmental complex”:

- **Raw material inputs**: supports livelihoods and the economy, e.g. fossil fuels, wood products, minerals, water, and fish
- **Life support services**: supports humans and wildlife in the form of a breathable atmosphere, clean water, and a livable climate
- **Amenity services**: provides opportunities for recreation, wildlife observation, and scenic views
- **Waste receptor service**: encompasses dispersal, transformation, and storage of residuals generated as by-products of economic activity
- **System stability and resilience services**: protects human activities against natural disasters and other sources of disruption

**How is Natural Capital Valued?**

Natural capital comes in diverse forms. Tangible forms (e.g. goods such as nontimber forest products) can be valued via income capitalization and stated-preference approaches. Intangible forms (e.g.
services such as erosion control or wastewater treatment) call for different approaches ranging from income capitalization (in the case of payments for ecosystem services or ecotourism for recreational values) to indirect market valuation approaches such as avoided cost, travel cost, hedonic pricing, and contingent valuation. Examples of some valuation approaches for intangible natural capital are shown in Table 1.

What is Social Capital?

Social capital is a multi-faceted concept relevant across land, resource, governance, and development fields. Although social capital eludes a single standard definition, the concept encompasses notions of trust, connectedness, social cohesion, and community involvement. Social capital is found to play a key role in the maintenance of natural resources that rural residents rely on for their livelihoods, particularly common-pool natural resources.

As an extension, some scholars argue that social capital is linked to the type and security of tenure rights over land and resources, and the decisions governing such resources. Given this, stronger social capital in a community is argued to underpin more sustainable resource use and management of collective resources, important in cases where legal property rights are unclear or not vested to the community using the resource. In that framing, a measure of social capital present in a community may serve as a reasonable proxy to indicate a community’s perceived tenure security over a particular land parcel.

How is Social Capital Valued?

Efforts to measure social capital are diverse in the literature, typically aiming to measure one or more facets of social capital. This is often done through a combination of ordinal rating or ranking scales, as well as numeric data on information such as number of civil society groups, extent of participation in such groups, and/or the amount of time that community members spend in civic activities. Different quantitative indicators to proxy the extent of community connectedness and participation in civil society are also widely used, as are different rating measures of respondent trust across different groups and community actors. Levels of agreement with statements indicating more connected, cohesive, trusted and reciprocal interactions within the community are also used.

There is thus a wide array of existing tools and survey instruments aimed at measuring different facets of social capital, which are available to draw on for developing a question bank to indicate the extent of social capital. When using a rapid assessment approach, there is a need to ensure the questions and tool structure fit within the envisioned implementation parameters, and provide the desired level of information across different kinds of tenure regimes and natural resources present in a community.
Efforts to attach a discrete value to social capital are uncommon, and attempts to place a specific monetary value on social capital appear to be very rare. This may not be surprising, given that social capital is an intangible, non-market good, and such goods are particularly challenging to value in economic terms. Hedonic pricing has also been very infrequently used to monetize social capital. A benefit of this method is that it can be derived from group-level information. However, this method also relies strongly on income and price information for market-based goods, such as house values, which do not as readily lend themselves to emerging-market contexts.

Valuation-Friendly Technologies

In mature real estate markets, land is valued using comparable sales or market value. This can draw upon the application of modern technologies in valuation, such as computer-assisted mass appraisal and remote sensing.

Computer-Assisted Mass Appraisal (CAMA)

In liquid markets for real estate and land, CAMA is typically used to value residential property for annual property taxation purposes. While CAMA is arguably more common in the property tax and municipal assessment arenas, the concept and use of it are widespread. Property valuation can be challenging as only a small percentage of property transacts in a relevant time period (e.g. 18–24 months) meaning that 100% of properties need to be valued with as little as 5% having sold during that period. Valuing each property manually and individually would prove prohibitively expensive.

CAMA has the power to infer the value of many properties based on an existing database of appraisals. CAMA works by analyzing the statistical significance to sale price of a small number of attributes that typically influence value. In the real estate world, these attributes include floor/plot area, habitable rooms, construction method, level of detachment and certain neighborhood characteristics, such as presence of local services, distance to a main road, and distance to a Central Business District. Release of this information provides greater market transparency, crucial in informing decision-making by land owners, occupants, and potential buyers.

Remote Sensing

Remote sensing is a technique used to derive information about the physical, chemical, and biological properties of objects without direct physical contact. Information is derived from measurements of the amount of electromagnetic radiation reflected, emitted, or scattered from objects. Markets with relatively sparse sales information and property characteristics can be potentially problematic when attempting to derive accurate and reliable valuations. Remote sensing offers the ability to locate data (e.g.
building identification, size, topography) using oblique imagery or other aerial viewing services, whether from a satellite or static flyover. LIDAR (light detection and ranging) is another aerial service that uses lasers to detect physical characteristics (e.g. tree height). Some are readily available and cheap (even free), while others may be very expensive.

To use remote sensing to inform land valuation, a number of key variables are identified that can be assessed and monitored using remote sensed data to for valuation in forestry and agriculture. Figure 1 shows a basic schematic of how the different approaches and components could be integrated.

Existing Community Valuation Tools

Initiatives promoting the integration of natural capital accounting into national wealth accounting attempt to place monetary value on various natural resources in an economy. Yet they generally focus their attention at the macro-level, overlooking the values provided to households and communities. The nascent field of social capital accounting is also likely to provide more information on the value generated through social networks, but to date the link has not been made between strong social capital and natural capital in valuation accounting.

Bringing theory down to practice, land valuation needs to be affordable and replicable if it is to be used by and for communities. Tradeoffs between cost and accuracy must be considered when selecting a valuation approach that can capture both social and natural capital. In terms of natural capital, Table 2 provides a comparative assessment of various existing decision-support tools, ranging from simple spreadsheet models to complex software packages, for valuing ecosystem services. Their evaluation criteria include (1) quantification and uncertainty; (2) time requirements; (3) capacity for independent application; (4) level of development and documentation; (5) scalability; (6) generalizability; (7) nonmonetary and cultural perspectives; and (8) affordability.

Among the 17 tools in the table, some may be complementary. For instance, ESR or Co$t\text{ing} Nature could serve as preliminary screening tools to evaluate ecosystem services of interest and create a broad framework within which to conduct more rigorous analyses from mapping and modelling tools that quantify landscape-level ecosystem services tradeoffs using biophysical models (e.g. ARIES, EcoAIM, Envision, EPM, In\text{VEST}, In\text{FOREST}, LUCI, MIMES) and surveys to capture social values (Sol\text{VES}).

Namati’s two-hour Community Land and Natural Resource Valuation Activity helps communities better understand replacement costs of their common lands and natural resources. The confidence- and trust-building preparatory exercise is intended to provide a quick grasp of the inherent value of common land to a community. However, challenges in data collection and analysis when using Namati’s tool include:
• Using a single replacement-cost valuation to accurately calculate the value of a combination of resources generated/used across diverse contexts: e.g. for household consumption or for sale, gathered from private or communally managed land
• Calculating the value of “lost” cash crop income, which involves factoring complex input costs, labor, opportunity costs, and transportation costs
• Incorporating resources that are harvested or used in irregular cycles or frequency
• Ensuring consistency of units of measurement and of price data
• Accounting for ecosystem services and intangible spiritual or recreational resources, currently not within the scope of the tool

Common Challenges with Existing Approaches

Traditional valuation approaches are grounded in a market approach to valuation and are closely allied to practices of financial accounting, based on benefit-cost analysis. Such valuation methods for commercial use of land and forests often do not consider intangible benefits important to community livelihoods. In summary, they may neglect to address several problems:

Overlooking of natural and social capital: Natural and social capital are frequently ignored in conventional valuation approaches. This is changing, as companies are beginning to use an increasingly diverse range of environmental and social metrics to help inform strategic, management, and operational decisions. Valuation of natural and social capital helps organizations understand their impacts and dependencies, either in terms of financial value to companies and shareholders or social and environmental values to local and other stakeholders. The finance community increasingly recognizes the commercial value of broadening information available to inform decision-making, to ensure all relevant factors and risks are taken into account.

Underestimating cross-media environmental effects: Valuation often focuses on discrete ecosystem services and fails to account for interaction effects, for example those between land, water, and air.

Lack of accounting for regulatory services and linkages between land parcels: The management of one land parcel may influence the productivity of nearby lands. For example, management of an upstream area could impact the health of croplands downstream. The positive or negative externalities in terms of crop land valuation may not be directly priced into the value of the upstream parcel. Land parcels may also be a source of pollinators and other forms of biodiversity that benefit croplands. These regulatory services are not directly priced or captured in normal valuation approaches, often due to risks of double-counting the value of regulatory services which may be embedded in products.
Limitations in reporting approaches: The financial performance of a company is judged by both its income statement and balance sheet. However, jurisdictions typically only compile income statements (GDP, i.e. the sum of income flows from natural resources) and pay little attention to the balance sheet (natural capital, i.e. the sum of income flows from various services provided by the whole ecosystem).

Need to measure flows rather than stocks: Valuation may be done in terms of natural capital stocks or flows. Godoy\textsuperscript{18} distinguished these two types – the first indicates the quantity (e.g. of standing timber) in the forest, while flow records the quantity extracted or used. The value of the stock is meaningless if not related to present or sustainable use. In addition, the difference between stock and flow can be large.

Misalignment of market value and economic value: Many policymakers argue that tropical forests have no economic value unless they are logged or farmed, which confuses economic value and market value (i.e. replacement cost). Everything can have economic value as long as it benefits humans, but only tradable goods have market value. Conventional economic value measures individual utility maximization over a discrete period. However, if it is to be sustained over time through sustainable management, economic value should be assessed by contributions (in all periods) to achieve individual utility, and include other factors such as social capital.\textsuperscript{19}

Inability to estimate spiritual value using a direct market-based approach: Traditional valuation methods would ascribe a low value to land that can neither be worked nor sold. Nevertheless, the sites could be seen as priceless by users if it has spiritual value, hence a valuation conundrum that seeks to derive a useful value between zero (market value) and priceless (community assessment). In the face of such use and disposal restrictions, market value approaches cannot operate effectively. There is a need to resort to other methods to assess the extent to which society places value on such land and to express it in monetary terms to facilitate meaningful decision making. Alternative options include contingent valuation approaches (where users are asked to estimate their willingness to pay for continued access and use) and cost-benefit analysis (which suffers some similar flaws as it uses market approaches to assess value, and is complex to implement).

Difficulty of assigning monetary value to nonmarket goods: It is difficult to assign a monetary value to nonmarket goods. For example, communally managed land often has no direct market sale or rent value, as communities do not have the statutory right to sell or lease the land in most cases. They may have the rights to access and use the land, but the rights they possess tend to be customary. Although informal markets may exist for tenure rights such as community shares and grazing rights, there are often no
transferable titles or transparent market evidence to support this. Godoy outlines several methods that attempt to approximate a fair value for nonmarket goods:

- Draw upon the market value of other goods used to barter for the good in question
- Use a close, priced substitute, requiring some price adjustment between the priced and non-priced products comparing their characteristics
- Calculate expenditures of labor or energy required to produce one unit of product
- Consider trade-off ratios to obtain a range of willingness to accept (WTA) and willingness to pay (WTP)

**Difficulty of determining the discount rate:** Parcel-level risks are not systematically incorporated into the discount rate. Sometimes they are factored in directly into cash flows. Potential risks to factor in include natural environmental risk, for example, climate or water risk. Anthropocentric risks could also be factored in, accounting for the level of risk in how natural resources are being extracted sustainably or overexploited, including a depletion risk premium. Other risks that may have a substantial impact on natural capital management, e.g. tenure-related risks, can also be considered.

**Need to use appropriate units:** Communities in rural areas may not use standard units to quantify the amount of a particular good or service being used. This creates challenges when quantifying the flow of goods/services and therefore the value.

**A Way Forward**

In the process of developing the tool, Indufor completed a literature review and consulted with professionals from civil society, government, valuation and remote sensing communities, and representatives in Rajasthan, India where the tool was piloted. Some key gaps identified from this process include:

- There is a clear gap for a valuation-focused tool for emerging markets that balances rigor with efficiency and integrates market and non-market methods.
- Existing tools to value ecosystems overlook tenure rights and are cumbersome to implement, requiring a high level of time commitment and technical expertise.
- Most existing tools take an ecosystem perspective rather than a community-focused unit of analysis and therefore do not integrate social capital.
- Existing valuation approaches are relatively lack in either relying on top-down regressions of existing market data or taking a bottom-up approach of valuing natural capital.
Ongoing initiatives with similar goals exist but are not advanced or still have limited scalability.

Opportunities identified include:

- A solid empirical basis for incorporating social capital into natural capital accounting exists.
- A new tool could enhance thinking related to how compensation approaches could be improved to more robustly measure and forecast the values communities derive from their lands, including communally managed resources.
- Advances in technology, particularly remote sensing and automated learning, offer opportunities to rapidly decrease the time required to identify property characteristics.

In response, Indufor developed a rural land valuation tool, detailed in the following chapter.
Chapter 3: Rural Valuation Tool

Efforts to develop valuation tools for ecosystem services have reached a fair amount of consensus on key criteria to meet in designing a valuation tool, detailed in the previous chapter. With these guiding principles and gaps in existing valuation methods in mind, Indufor set out to develop a rural land valuation tool for emerging markets that integrates market and nonmarket methods to produce primarily quantitative data, captures both social capital and natural capital in diverse settings, and balances rigor with efficiency. Indufor developed an Excel version of the valuation tool, as well as an Android-compatible mobile application of the tool for easier in-field entry.

The tool requires strong community participation, with guided facilitation by NGO or agency staff with prior community entry and qualitative data collection experience on land, resource, and governance issues within communities. The tool is designed to be implementable over two days of meetings per community. It is designed to yield a valuation that can be disaggregated by different natural resources and activities, as well as assess the tenure security or statutory use rights than may vary across these resources.

The logistical constraints imposed by this design necessitate tradeoffs in terms of the level of detail that can be obtained and the accuracy of valuation figures. However, this initial proposed tool should be viewed as a prototype to be further refined and potentially expanded. For now, the tool can be used to produce valuations that indicate the general magnitude of net benefits a community derives from a land parcel. Validation using more technical assessments is needed for at least initial benchmarking to ensure that community-based results are within a reasonable margin of error.

Overall Valuation Framework

The Rural Valuation Tool uses a discounted cash flow (DCF) method to estimate the value of a land parcel with defined boundaries. Based on historical data and community survey information, the model projects the trends of key variables to simulate future cash flows (in n years), and incorporates a sovereign risk premium and social capital premium into the discount rate (r). The corresponding equation is:

$$DCF = \sum_{i=1}^{n} \frac{CF_i}{(1 + r)^t}$$

The tool supports natural capital accounting in rural environments, and by default accommodates the tangible benefits and costs associated with harvesting of forest products, grazing, agriculture, mining,
and use of water from water bodies. It can also be used to value the more intangible benefits and costs associated with recreation/spiritual value. In the case of the latter, intangibles are generally still valued based on a direct use-value approach,\(^{23}\) for more conservative and easier accounting, as well as relative comparability across parcels.

Social Capital

The concept of social capital broadly encompasses notions of trust, connectedness, social cohesion, and community involvement. Empirical evidence\(^{24}\) shows that social capital plays a key role in the long-term maintenance of natural resources that communities rely on for livelihoods. \(^{25}\) Communal managed parcels where tenure rights are strong and community management institutions are well-functioning tend to have a better maintained resource base in the long run. In order to assess the impact of higher or lower levels of social capital on land value, Indufor integrated a social capital score into the discount rate.

Drawing from literature review, Indufor developed a qualitative assessment tool for evaluating social capital. Indufor piloted a full version (10-page) of social capital questionnaire, but found it inefficient for community focus group discussions. Therefore, Indufor revised it to a shorter version with a set of 14 questions focusing on core objective indicators measuring the level of land tenure security, community cohesion, and resource governance capacity. Together these questions reveal a community’s ability to sustainably manage and benefit from natural resources on a specific parcel.

For private sector investments, credit ratings are made to establish creditworthiness on a debtor’s ability to pay back debt by making timely interest payments and the likelihood of default. Credit ratings affect the interest rate at which a company can borrow money, and the expected returns of a security, with higher ratings leading to lower interest rates.\(^{26}\)\(^{27}\)\(^{28}\) Similarly, the level of social capital security influences the risk or creditworthiness of deriving future benefits from the land for local communities. With inspiration from credit rating approaches, Indufor developed a social capital ratings approach to translating the qualitative results of social capital survey into a rating that can feed into the discount rate portion of the DCF model.

The social capital quantification approach is similar to Moody’s corporate risk assessment methods. Moody’s ratings are forward-looking, reflect expectations of future financial and operating performance, and enable informed peer comparison of companies. The major factors used by Moody’s for building qualitative risk indicators have been adapted in our approach to include:

- Level of risk taken by land owner, occupants, and investors, combining sovereign and parcel-level risk
- Level of land tenure security
- Level of community capacity and experiences in managing the parcel

Indufor developed a questionnaire regarding the above factors, assigning different weights (Table 3) and scores for each question and answer (Table 4). The results of the questionnaire produce a weighted-sum social capital score of 0-20 (20 being the highest score corresponding to highest social capital) that allows for comparison of social capital across land parcels.

The highest weight (a total of 55%) is given to land tenure security for its critical role in enabling sustainable land management. Land tenure sometimes used interchangeably with property rights. Property rights are more inclusive, with property broadly ranging from land and real estate to movable assets, or even intangibles like patents and ideas. Land tenure on the other hand is defined as the relationship that people, groups, or entities have with land and land-based resources. The relationship is defined by rules that guide how land is allocated, used, managed, and transferred. Rules related to land tenure, either customary or statutory, can create powerful incentives for land and resources management. Positive incentives provided by secure land tenure could provide the foundation for a sustainable development plan with a long-term horizon. Communities tend to be more willing to conserve resources and invest in improving land if their tenure rights are secure and recognized. On the contrary, without secured and recognized tenure, people might be more likely to overuse land.

The social capital scores correspond to 20 different notches, each of which corresponds to an alphanumeric rating (Aaa - Ca) according to Moody’s criteria (Table 5). The rating in turn links to an estimated discount rate spread (0%-12%) based on current market interest rates. The discount rate for a DCF model would be determined by the following equation:

\[
\text{Discount Rate} = \text{Risk Free Rate} + \text{Sovereign Risk Premium} + \text{Social Capital Risk Premium}
\]

\[
= \text{Sovereign Risk Rate} + \text{Social Capital Risk Premium}
\]

Sovereign risk rates are unique to each country and updated periodically. In practice, it is recommended to use the interest rate of the country’s 10-year Treasury Bond as a proxy for the sovereign risk rate. Parcels that score a 20 are assigned the same discount rate as the sovereign risk rate, with social capital risk premiums added for each notch below 20.

Natural Capital

Natural capital is commonly thought to encompass the aggregate assets or stocks that provide both natural resources (tangible) and environmental services (intangible).
Tangibles

Tangible natural capital comes in a wide range of forms. Informed by literature review, Indufor built valuation models for agriculture, harvesting of timber and non-timber forest products, grazing, aquaculture production, fishery production, artisanal mining, housing/real estate, and vacant land. For each land use activity type, Indufor performed cost-benefit analysis, and designed questions for collecting historical data and projecting future trends.

Following field testing in India, Indufor adjusted survey questions to be more applicable for data collection at the community level. The language of questions was rephrased to acquire information more specifically. Indufor also took other rural-contextual problems into consideration, such as data availability of community surveys, seeking proxies for market price in a non-market area, scientific conversion of local units, physical land types and legal land uses. The refined tangible natural capital questionnaire focuses on five modes of tangible natural capital: 1) harvesting of forest products, 2) agriculture, 3) grazing, 4) mining, and 5) water use.

The approach to estimate annual cash flows ($CF_{x,i}$) for harvesting of forest products, agriculture, and mining is straightforward because products are directly consumed or sold by individuals or the community. Key variables include harvesting/extracting frequency ($f_{x,i}$), quantity harvested each time per household ($Q_{x,i}$), number of households ($H_{x,i}$), and market price of the harvesting/extracting product ($P_{x,i}$). The annual cash flow for benefit $x$ of year $i$ equals:

$$ CF_{x,i} = f_{x,i} \times Q_{x,i} \times H_{x,i} \times P_{x,i} $$

It is possible to value these flows of natural capital through the flow of net benefits from direct products because they also are end products. For instance, fuelwood gathered in forests can be directly used by households or sold on the market. Thus, fuelwood is both a direct product (acquired from the land) and an end product (consumed/sold). However, fodder is not an end product but rather an input for other products. In this case, the end products of fodder-based natural capital include livestock (e.g. goats, cattle) and their byproducts (e.g. milk, meat, hide). Figure 2 explains the relationship between direct products and end products.

The avoided cost approach can be used to value flows of natural capital for which income data for direct products are not available. For example, fodder grazed or cut-and-carried off of a parcel of land provides benefits in the form of avoided costs, i.e. what people would have had to pay by buying an equivalent amount of fodder from the market. Annual avoided costs for fodder can be estimated based on estimates of the amount of fodder from this parcel consumed by each livestock in a year. Key variables...
include number of months of a year grazing livestock on the parcel \( M_{x,i} \), total amount of fodder consumed per animal per year \( Q_{x,i} \), number of livestock \( N_{x,i} \), and market price of fodder \( P_{x,i} \). The annual flow of fodder benefits consumed by animal x of year i equals:

\[
CF_{x,i} = \frac{M_{x,i}}{12} \times Q_{x,i} \times N_{x,i} \times P_{x,i}
\]

Similarly, water acquired through the physical water body on this parcel can also provide benefits in the form of avoided costs. The amount of water use should be accounted for thoroughly by including both on-site water use and the amount of water extracted for use by individual households and public forums offsite. Examples of onsite water use may include drinking water for livestock, and water for laundry and bathing. Community-reported data on the amount of water use can be validated against measurements of the annual carrying capacity of the water body.

Historical data collected through community surveys are used for analyzing and understanding patterns and trends of generating benefits from the land. Based on the analysis, Indufor project future cash flows of each benefit with the consideration of economy inflation and future community development plan. 15 years is set as the standard number of projection years across all land use activities, as a result of extending the period of shorter-term natural resource management regimes for agriculture, grazing, and mining to be standardized and matched with the period used for longer-term management regimes for timber and other forest products which are based on longer harvest rotations.

To quantify the benefits derived and put a monetary number on land value, it is necessary to introduce a market price for products. However, obtaining market prices can be difficult in rural context, especially in areas there are illiquid markets. Other public data for market prices are available. For instance, the minimum daily wage at state level could be used as a proxy for labor cost, and average market prices for clothes or shovels (products purchased on the market) can be used for calculating the market price of fodder or crops on a barter system basis. Currency and units used for data collection should be standardized during the land valuation process.

**Intangibles**

*Spiritual and Recreational Value*

A site with spiritual or recreational value can include significant built infrastructure and/or natural infrastructure. The natural capital approach discussed above can be used to value any direct products that can be derived from a parcel, for instance fuelwood and fodder from a sacred grove.
To value the more intangible spiritual or recreational value of a site requires a different approach. For that, the tool provides guidance inspired by the travel-cost method to estimate the aggregate opportunity costs and actual expenses incurred by people traveling to and using the site as a proxy for the spiritual or recreational value they derive from the site. Expenses such as donations may also be factored in as a proxy indicator of how much people value the site. Costs incurred to maintain a site, for example to restore or enhance certain elements, can also indicate value. However, valuation should be done carefully so as not to double count values, for instance by counting donations that go toward site maintenance.

Given the major costs to conduct traditional travel-cost studies, the guidance for the Rural Valuation Tool proposes a streamlined version relying on averages and community estimates. Averages could be derived by conducting a survey on the amount of time that people spend visiting for major events such as an annual festival, versus the amount of time that people spend visiting regularly, and finally for irregular tourism. Averages can also be derived for the amount of distance that people travel from different regions, and associated average travel expenses, e.g. spent on gas or public transportation. Average socioeconomic levels will also need to be derived as a crude measure of inferring the opportunity cost of people traveling from different regions. Ideally the survey could be done in person at major events or indicative days, but short of that, data validation will be needed for community estimates based on recordkeeping for visitors and donations. This may be difficult in areas where there is no entrance fee nor formalized entry documentation (e.g. check-in process, book signing).

When calculating the cost spent traveling and at the site, the cost should be discounted because people will also be deriving benefits from visit itself, as well as the journey. The discount factor can be adjusted in a sensitivity analysis based on case-specific factors, for example if the travel route is more or less scenic, or if the trip is multipurpose.33

Key to consider is that the number of hours spent at or traveling to a site may not be necessarily correlated with the actual spiritual benefits obtained from the site. For instance, people may frequent a church every week of the year but potentially derive a much greater amount of spiritual value from visiting a unique temple once in their lifetime. Contingent valuation could be used to estimate the worth of such sites, but would require extreme care about phrasing, which could be sensitive depending on the payment vehicle but also may risk misinterpretation by people who may suspect that they will lose free access to the site, depending on the country and local settings. The travel-cost method would provide a cost-based approach as an indication of willingness to pay in actual and opportunity costs to maintain, access, and use
a site. This would anchor the valuation of these sites based on concrete assumptions, which could understate the ‘priceless’ value of such sites but be more defensible than contingent valuation.

Syncing the Tool with Other Methods on Intangibles

Some intangibles are less amenable to a rapid rural assessment approach using back-of-the-envelope estimates made by individuals or communities.

Carbon

The tool itself does not develop unique guidance on carbon accounting, but refers users to existing best practice. To account for the value of carbon sequestration, a community can use an income-based approach assuming some change in management or change in threat level that would result in additional carbon benefits. This should be done with an NGO or project developer with carbon expertise. It is recommended that users value carbon sequestration based on what is additional and monetizable through carbon finance. Some have valued carbon sequestration based on total forest stocks rather than figuring out a baseline against which to estimate carbon sequestration that would not have occurred under business as usual. However, this may overstate and mislead about the actual marketable value of land. Carbon quantification methodologies are available from independent third-party standards such as the Verified Carbon Standard to measure and project net carbon sequestration (and emissions) levels around sustainable forest and agricultural land use activities. Using an income approach, carbon revenues can be valued by multiplying an average offset market price against the total verified and/or projected tonnes of carbon dioxide equivalent sequestered over a project period in a set geographic boundary. Income can be netted out by considering project development, certification, and any transaction costs.

Watershed Services

Beyond the direct flows of water provision that can be valued through avoided cost, other watershed services such as erosion control, enhanced soil quality, increase in total water yield, stabilization of streamflow distribution, and control of sediment in streams are harder to value accurately, particularly using a rapid community-based approach. For example, valuation of indirect benefits of improved commons management such as increased crop yields due to enhanced water flows relies on a technical understanding of hydrological flows in order to accurately attribute the relationship between commons and other parcels. It is therefore incompatible with the current community-based rapid survey approach. A more technical hydrological assessment could be done. Limited benchmarking could be done against existing watershed investment programs, e.g. what people are willing to pay for water rights via local user fees, though
generally pricing for PWS schemes is more variable and over-the-counter compared to carbon given its inherently localized nature.

**Biodiversity**

The tool does not develop new methods for valuing biodiversity, but refers users to existing approaches while providing caveats against double-counting. Valuing biodiversity is a complex matter and can encompass both instrumental and intrinsic values. For instrumental values such as crop pollination, relevant in the context of FES’s work in India, an avoided cost approach could be used, however, risks double-counting the value of crops. Income approaches could be used in the presence of ecotourism. More broadly, contingent valuation has been the most often used method for valuing biodiversity, given the inability of other valuation methods to gauge passive or nonuse values of biodiversity. Contingent valuation has major limitations and given its limitations to recognize the entire range of biodiversity benefits, provides at most a lower bound to the value of biodiversity changes.

**Built Capital**

Spiritual value can be attached to both natural environments (e.g. sacred grove) and human-made structures (e.g. temple). In the latter case, the tool allows users to include the building value as part of the parcel value, a proxy for the cost undertaken by communities to build a similar structure if the building were destroyed. Usually, replacement cost approach is used to calculate the building value deducting annual depreciations.

**Tool Outlook**

Currently, the Rural Valuation Tool focuses on the direct products supplied by a land parcel, which provides a relevant if not comprehensive accounting of the values that people derive from land. Although the direct use values from water supply are accounted for, more indirect benefits of improved commons management and technically complex ecosystem services such as carbon and biodiversity are less compatible with a rapid bottom-up survey effort and require more intensive technical studies. Even the initial valuation results based on community-based estimates of direct products such as fodder, fuelwood, and water are not very accurate, and require data validation.

Therefore, for the tool to better reflect the value of the commons to communities requires complementing the rapid bottom-up surveying approach with technical inputs, whether from primary or secondary data sources. For the tool to be truly scalable requires complementing the on-ground surveying
approach with productivity data (e.g. as a function of NDVI, market access, slope) from GIS and remote sensing efforts as envisioned through the CAMA part of the valuation tool.

The need for improvements notwithstanding, learnings from field testing and feedback from FES, communities, and relevant practitioners and scholars overall reinforced the potential of and interest in using the tool to provide versatile support. It could provide cost-benefit analysis, comparisons of value (e.g. before and after management, poor versus strong social capital), and decision-making support to explore different future scenarios based on varying natural resource management and investment decisions.

In the future, this tool could be synced to value both rural and urban lands across diverse settings, as well as capture additional types of natural capital benefits and social capital factors. The current tool is limited to inland natural resources. For coastal and marine areas, Indufor has developed generic economic models for measuring flows from other activities, such as aquaculture and fisheries production, as well as explored appraisal of real estate properties in rural areas. The social capital survey could be adapted to fit the context of different natural or built resources. Additional field testing would be needed to test and refine the tool for these other resources.
Chapter 4: Valuation with GIS, Remote Sensing, and Computer-Assisted Mass Appraisal

In its current form, the Rural Valuation Tool is applied one parcel at a time. Tool use and access to community land valuation data are therefore likely to be limited to communities with strong internal capacity or NGO/other support to collect data and calculate inputs for a discounted cash flow model. Even with strong community capacity, valuation requires data validation. In addition, when looking at scaling up valuation across thousands of parcels, the level of primary data collection required to value land using the tool is no means economical or logistically feasible to value all relevant land parcels across a particular region or country.

Geographic information systems (GIS) and remote sensing could complement community-based efforts, providing a reference for data validation at the parcel level. They could also potentially be used to inform a Computer-Assisted Mass Appraisal (CAMA) approach. This chapter first discusses the value of GIS and remote sensing to inform valuation at the parcel level. It then discusses the role it could play in informing CAMA-based valuation across a broader set of non-surveyed parcels, calibrated with valuation data from surveyed parcels.

GIS and Remote Sensing

Satellite image can provide relevant information to complement community-reported information during the land valuation process. For example, satellite imagery can be used to produce base maps that show land cover. Field testing of the tool during piloting in India confirmed that high-resolution imagery can be used to create land cover maps at reasonable accuracy without detailed knowledge of a local area.

Unlike land cover mapping, boundary mapping requires detailed local knowledge, which may limit the applicability of satellite imagery. A more realistic alternative is to measure with Global Positioning Systems (GPS), or confirm these boundaries using freely available Google imagery during community consultations.

Once parcel boundaries are established, satellite imagery can also be used to monitor land cover change. Freely available imagery from the United States Geological Survey (USGS) and the European Space Agency (ESA) provides information (10–30-meter resolution images) that can help map the status of natural capital on land, for example identifying changes in vegetation cover and reservoir levels in line with changes in season. This type of information could be used to validate historical data and projected
trends used to produce a community-based valuation. Vegetation growth across the commons is highly seasonal, which means consistent image timing is important to allow for comparisons. The relative accuracy of biomass estimation is key as it allows for data validation of community-reported inputs and also for scaling up of the valuation tool through CAMA, which is described below.

**Computer-Assisted Mass Appraisal**

CAMA has been used to infer the value of certain properties from an existing database of appraisals, leveraging data on major attributes from a database of already appraised properties. As a statistical model-driven property valuation approach, CAMA has the power to allow the wider use of a limited yet representative amount of evidence on land and property value.

Data on land values are often scarce in rural areas of emerging markets. In India, the initial country where the Rural Valuation Tool was field-tested, land value data is non-existent for revenue wastelands. In response, inspired by the CAMA approach, Indufor and Ulster University explored the potential to adapt CAMA for complementary use with the Rural Valuation Tool in rural areas. CAMA may be feasible for both the pilot study market and future valuation sites, but requires a larger sample size and a significant amount of ground-truthing in order to be operationalized with rigor.

CAMA is typically carried out in three major stages:

1) Collection and cleaning of data to ensure they are robust and representative

2) Statistical modelling to prepare a valuation model, run in an iterative fashion to build the model that most accurately estimates land values based on market sales evidence

3) Checking of model accuracy, comparing the estimated values with the sales price data, against a number of standard benchmark tests

The legitimacy of CAMA model outputs depend upon the rigor, accuracy, and reliability of valuation data inputs. In the case of the Rural Valuation Tool, pilot valuations serve as a starting point, playing an equivalent role that sale prices would play in CAMA for more liquid real estate markets.

Careful selection of attributes is needed to adapt CAMA to complement the Rural Valuation Tool. Considerable variability exists across key attributes. Key attributes also change through time, with no requirement to inform valuation authorities. It is therefore a clear advantage to build models parsimonious in their use of data and based upon easily obtainable data.
To be useful, the attributes used to build the valuation model must be known for all the properties in the wider population that are to be valued. For instance, while fodder productivity may prove statistically significant to value within the sample of properties used to build the model, it cannot be used for CAMA if the fodder productivity of properties is unknown for the wider population.

Valuation accuracy depends on community capacity to use the underlying tool, and the validity of the valuation methods underlying the tool. It is essential that measurements be standardized and definitions of all terminology used be as explicit as possible. Meanings of words, particularly culturally and geographically varying ones (e.g. bigha), need to be conveyed explicitly to both survey respondents and team members to standardize and reduce potential for estimation errors introduced from subjectivity.

CAMA accuracy is measured by the extent to which the CAMA-estimated land value corresponds with the original valuation. Should the CAMA model prove adequate to predict the sample site values, it can be confidently deployed to assess land values in the wider population of sites. This depends upon the sample sites being broadly representative of the population at large and adequate data on significant attributes being known or capable of being discovered for all sites.

Model Development

The information collected from communities using the Rural Valuation Tool represents the primary input, with the second component drawn from GIS and remote sensing for inclusion into CAMA. As each land parcel is unique, additional information is required to scale up and provide a wider census to improve the representativeness of valuations. Remote sensing and GIS can help move from valuation of individual or groups of parcels to a mass appraisal of land.

Given the requirement to use simple but data-rich attributes when developing a CAMA approach, natural capital at this stage is crudely defined as the actual biomass of a parcel which is used by the community, where biomass is a proxy for a broader set of environmental quality and productivity.

Social capital on the other hand represents multiple factors including tenure security, institutional capacity, and management practices. Remote sensing at this stage is not applicable to social capital. Relevant GIS data is available, for instance on conflicts at the district level is available for India, but provide a poor proxy based primarily on the observation of negative cases (i.e. conflicts), compared to assessing social capital through discussion with local communities which also sheds light on positive elements of land tenure and institutional capacity.
Scaling up the valuation methods would be easier if there were a linear relationship between natural and social capital. This could be reasonable, as there is evidence from various cases of commons management, e.g. in community forest management, that communities with greater social capital enjoy higher natural capital. However, there could also be exceptions to the case, for example if strong social capital compelled a community to diversify livelihoods away from natural capital. The exact nature of this relationship in this context is uncertain, to be clarified as additional parcel data is collected. More realistic at this stage would be to initially refine CAMA methods for natural capital valuation, disaggregated from the social capital elements.

**CAMA Inputs**

To keep the model simple for initial scaling up, it would be practical to constrain the analysis to the parcel level. This would involve calculating the average Normalized Difference Vegetation Index (NDVI) or biomass value for each land parcel. Based on the standardized NDVI value, or modelled biomass, all parcels would be placed into one of four quality categories: very good, good, medium and poor based on the level of biomass. In addition, other information including coordinates of the central point of the parcel derived from GIS analysis will be included as input for CAMA. Table 6 shows the simplest input form for CAMA as derived from field survey and RS analysis.

Although NDVI is considered a good indicator of vegetation presence and vigor, it does not provide a direct measurement of biomass. It is known to vary across different images (even from same sensor) due to sensor geometry, sun illumination angles, and differences in atmospheric conditions during imaging. As CAMA would require multiple image scenes across different environments, standardization of the NDVI value will be necessary. Several image standardization techniques exist. Once NDVI values are normalized, then they can be used as a proxy for biomass. This approach could be further evaluated using field biomass measurements. A sufficient number of biomass measurements are needed to develop an NDVI-based biomass model.

Additional analysis of remote sensing images is possible and best pursued using cloud-based processing methods that access freely available satellite imagery.

- **Within-parcel analysis**: A high degree of variation of land cover can be expected within each parcel. Further improvements could include identifying the percentage of good medium and poor areas within each parcel, classifying them based on standardized NDVI or modelled biomass. Table 7 shows an example of the resulting CAMA input form that includes additional information.
This approach is routinely used by Indufor to monitor the productivity of forest plantations. The process uses satellite imagery and in-house routines called Sattools to build a model to evaluate stand performance and variability, and to detect areas of anomalous growth. An example output is provided in Figure 3, which compares the satellite image (right) against the derived variation map (left). This routine could be modified and applied to further refine the value attributed to each commons parcel, and improve the sensitivity of CAMA outputs.

- **Woody and non-woody biomass:** Grassland biomass as an annual crop is well represented by the seasonality of NDVI time series, but woody biomass—perennial in nature—holds a permanent biomass component as well as a seasonal one. For example, a closed grassland may have very few trees and be managed for fodder production, resulting in a high NDVI value in the peak season that rapidly decreases as the grass is grazed or dries up. A closed forest may record a higher NDVI value throughout most of the year but be overtaken by the closed grassland post-monsoon.

  In summary, the NDVI time series represents both the seasonally changing biomass and the consistent biomass that remains unchanged over time. It is possible to apply techniques such as an STL algorithm to decouple the NDVI time series to split out the woody and non-woody biomass proportions.

The proposed CAMA approach is intended to be deployable with an affordable level of digital data inputs. The approach would provide a valuable stepping stone to more sophisticated uses, perhaps harnessing Geographically Weighted Regression and more delineated biomass assessment.

In addition to biomass, other indicators may be factored into an environmental quality index, including market access (potentially approximated by distance to city center, or as a function of population density), slope, and water risk.

**Is the Approach Robust?**

The central limit theorem and the law of large numbers are commonly cited foundations in statistical theory that convey the importance of a sample size being large enough to reflect the behaviors of a desired population. A sample size too small will result in inaccurate, unreliable estimates of value. While observations in a sample must reach a certain level before a model may be deemed reliable, the acquisition of additional data points can often be costly, or in some cases, severely limited. Reichert states that with respect to property valuation models, a sample will ideally have at least 30 observations per variable, with
no fewer than 10 observations per variable as a bare minimum. Similar sampling suggestions are echoed by modelling valuation courses taught by the International Association of Assessing Officers (IAAO).

Overall, the outlook of large-scale CAMA execution for estimating annual income, gross income multipliers, and overall value is uncertain. The availability of benchmark stamp rates (such as Rajasthan’s DLC rates), 2011 census data, remote sensing capabilities, and explicitly defined survey terminology provide an optimistic outlook for efficient scalability. However, attributes related to both natural capital and social capital each have unique considerations to address before being able to feed into a larger-scale approach. In particular, there are challenges to accessing standardized data on attributes related to tenure security and land productivity.

The social capital survey requires community input and there is no real analogue for secondary data collection for non-surveyed sites at a regional level. Legal classification has some influence on tenure security but is only one factor. In the pilot areas in India, three legal land types were identified, associated with varying degrees of tenure security: pastureland, forestland, and revenue wasteland. However, there were dramatic differences in the level of social capital even when comparing two parcels that shared the same pastureland legal classification, partly due to the difference in maturity between village pastureland management committees and rulemaking.

Legal classification can also not be used to determine specific land use, which is relevant for natural capital valuation. From field-based analysis, it has been found that all three of the land classifications encountered during piloting—pastureland, forestland, and revenue wasteland—were being managed as silvopasture, that is, a blend of forest product harvesting and pastoral activities. Initial piloting for a CAMA approach would best be done in an area where de facto land uses are relatively predictable and consistent with existing legal or other classifications.

More investigation is needed to determine how to reconcile the valuation approach for existing parcels which is based on current income and resource flows which typically does not match full biophysical productivity or potential. It would also be necessary to know how the rankings of very good, good, fair, and poor would be determined—relative to land values determined in a certain region, or against some absolute biophysical standards. In the former case, a large and diverse sample size would be required in order for rankings to be somewhat meaningful. Otherwise it would be hard to prove external validity. In the latter case, biophysical standards may also need to be evaluated against some intended land use in mind, in which case dealing with the challenge of defining highest and best use. For example, scientific standards for what
would make ‘very good’ biophysical productivity would differ if the land were to be used for mining versus for working forestlands to be harvested for forest products. By the same token it would be held to a different standard if the land were to be used for preservation of certain protected species.

In short, such value assumptions would affect the type of multiplier adjustments. Until these questions are solved, it would be challenging to scale up valuations produced from the Rural Valuation Tool using a CAMA approach based on biophysical productivity, given the lack of standardized and representative attributes with which to cross-compare parcels. Instead, the CAMA approach would need to be based primarily on existing valuations drawing on current rather than potential use. Given the bias toward income-based and tangible use values, the value of intangible values may risk being underrepresented.

Remote sensing would remain relevant for data validation purposes. However, it would be difficult to use remote sensing to conduct CAMA and estimate the value of nonsurveyed parcels based on surveyed parcels. For more complex forest ecosystems in particular, remote sensing would be insufficient to determine whether a nonsurveyed forest is being used in a similar way to a surveyed one. If would therefore be illegitimate to extrapolate the value from the surveyed forest to also apply to the nonsurveyed forest, if the land uses and harvested products are different in nature.

**Refining the CAMA approach**

More work is needed before a CAMA approach can be developed for natural and social capital. Land valuation approaches from other jurisdictions may provide some point of reference. For example, the State of Arkansas in the United States bases its valuation of pastureland, cropland, and forestland on average productivity, using income to approximate value, for different soil classes, disaggregated by land use type. Soil groupings are based on the NRCS Land Capability Classification System (US-specific), indicating various limitations, e.g. water, erosion, or shallow/unstable soils. They have 18 different categories, more granular than the initial 4-category system being considered here. Given the difficulty of getting comprehensive soil data, in India’s case, NDVI could be used as a proxy instead, with other indicators such as slope, water risk, and market access factored in eventually as part of an environmental quality index. A significant body of valuation samples would need to be accumulated for different land use types in India using the Rural Valuation Tool before it could be relied on to estimate the value of unappraised land.

Other next steps for India-specific investigation include identifying comparable ‘markets’ based on socioeconomic data from census data, as well as the availability of benchmark stamp rates by property class, as exists in Rajasthan where the initial tool piloting was done.
Once an approach is settled upon for the scaling up of natural capital valuation, more investigation would need to be done into social capital.

If a CAMA approach is found to be feasible, additional attention would also need to be paid to how the information would be used, sensitive to cultural norms and laws around privacy.
Chapter 5: Case Study: Valuing the Commons in India

“How many pula of fodder do your cattle eat every day?” asked a Foundation of Ecological Security (FES) staff member. Fifteen men, women, and children had formed a circle outside in Kyara ka Khet, a hilly village in Udaipur District, Rajasthan. They burst into laughter.

“Two,” some called out. “Three!” chimed in others.

“Why are they laughing?” Indufor consultants.

“Wouldn’t you find it funny if someone came and asked you about how much food you or your livestock ate every day?” the FES staff member explained. “They see this as entertainment.”

“What percentage of that fodder do you get from the Veelva forest?” she asked the group again. Active debate ensued.

Livestock from Kyara ka Khet and three other villages rely on some fodder from the communally managed Veelva forest. However, they also rely on fodder from private cropland and from other common lands, depending on the month of the year. The dynamics are complex. Engaging community meetings were followed with dry late-night sessions spent calculating the total amount of fodder consumption and comparing that against biomass studies. Fodder consumption estimates, multiplied by market prices, fed into a discounted cash flow model. Estimating the value of fodder that communities derive from common lands proved one of the most difficult questions faced during the initial piloting of the Rural Valuation Tool.

Piloting efforts in Rajasthan showed that communities would like to calculate the value of their land. In particular, they expressed interest in the potential to use data to advocate from stronger land tenure rights. Through field testing it became clear that valuation based on data collected from rapid rural assessment-style community meetings can provide a useful if rough indication of land value. However, to be sound, community-based valuation efforts must be complemented by strong local NGO intermediary support and data validation efforts, and more technical assessment of ecosystem services and intangible values when relevant.

Early Movers

In the summer and fall of 2016, members of FES, Indufor, and Ulster University tested the tool on six different commons in the Bhilwara and Udaipur Districts in Rajasthan, together with communities.
FES was an ideal first user of the tool. Established in 2001, the Indian NGO collaborates with a broad network of communities to strengthen tenure rights and land stewardship. In total, FES assists 11,704 village institutions across six ecoregions of India to support ecological restoration on degraded “commons,” or communally managed land, including revenue wastelands, forestlands, and Panchayat grazing lands. The organization has a strong history of collecting field data for many years, already having distributed an estimated 500 tablets with GPS capabilities to local teams throughout the various regions, together with training on Open Data Kit for data collection. The eventual goal is to establish local portals through which communities can readily access geospatial data for decision-making.

After learning about the proposed rural land valuation tool, FES staff shared their interest for a robust yet simplified approach to valuing the commons. Through consultations with local communities, FES staff and government officials, the team decided to focus on the commons rather than other types of land. The commons are critical for livelihoods in India, yet tenure rights associated with them are comparably vague and complicated, presenting potential risks that may drive future land disputes. Indian government currently has no standardized process to comprehensively value common lands. The commons also produce services to support intensive or complex land uses (e.g. mixed land uses such as silvopasture) by multiple communities, susceptible to overexploitation if management is weak.

**Pilot Sites**

Valuation efforts focused on commons where FES already has a long history of supporting village institutions to improve forest management and agricultural practices. In the villages that field-tested the tool, FES had already helped implement conservation and regeneration practices such as bunding, tree planting, and hydrological works. They had also assisted with local institution building, for example by helping establish village committees to oversee rulemaking on shared resource management. Together, the pilot commons captured a diversity of closed versus open commons used for a mix of forest and pastoral activities, across grassland and forest ecosystems.

*Bhilwara.* In Bhilwara District, field testing included tropical semi-arid grasslands in the villages of Mala ka Khera and Mukungarh. These villages are part of the Kalyanpura watershed, which stretches across 5,000 hectares covering around 1,800 households. Livelihoods are largely based on livestock rearing and agriculture. Livestock rearing primarily occurs on the commons throughout eight months of the year with additional feed derived from food residue for the remaining months.
Land transactions and conflicts with outside interests have been infrequent. However, in recent years, there has been some land encroached upon for mining, and anecdotal cases of internal conflicts wherein certain powerful actors within a community encroach on commons for agriculture.

In Mala ka Khera, efforts to pilot the Rural Valuation Tool focused on valuing the open grazing land, and the closed grazing land which also includes the Basbaada Mataji Temple. In Mukungarh, the pilot efforts focused on valuing the open grazing land and closed grazing land. These commons are particularly important for the livestock grazing and fuelwood collection, as well as spiritual and recreational value in the case of the temple. Village pastureland development committees were established in both villages in the late 2000s with FES support, with rules regulating access, use, and management of these sites.

**Udaipur.** In Udaipur District, field testing centered around the tropical semi-arid Veelva forest. The forest has historically been accessed, used, and managed by people from four local villages—Kyara ka Khet, Richwara, Sakaria, and Chitrawas—via a Village Forest Protection and Management Committee (VFPMC). The VFPMC was established in 2002 under a joint forest management (JFM) arrangement in a tripartite agreement between the villages, the Forest Department, and FES. Village livelihoods are largely based on subsistence agriculture, livestock rearing, and daily wage earning. Overall these villages rely on income from nontimber forest products more than from livestock products, and have far fewer livestock compared to the villages in Bhilwara.

**The Process**

All field testing visits included working sessions with FES staff, development communications materials to explain the goals and content of the valuation exercise, and community meetings for data collection and validation. For each commons, the team spent two days with villagers, typically over with a two-hour meeting each day. Community participation was voluntary. The field testing was completed using paper copies of the survey, later entered into an Excel version of the valuation model, with calculations done keeping with the valuation methods explained in Chapter 3. An Android app-based version of the tool was also troubleshot during the field testing with the aim of providing a more user-friendly interface for data collection and valuation results calculation.

In addition to carrying out community-based survey efforts with FES, Indufor and Ulster consultants also investigated how remote sensing and GIS data could be used to generate natural capital valuations and be complemented by computer-assisted mass appraisal (CAMA) approaches.
Measuring Social Capital

For each commons, the piloting team asked villagers questions to gauge their level of social capital, with special attention to tenure security.

Findings. Social capital scores, reflected in the discount rates, varied a great deal across the communities and parcels (See Table 8). Discount rates ranged from 11.66% for Mukungarh’s open grazing land down to a much more stable 7.76% for Mala ka Khera’s closed grazing land (strongest performer). In Mukungarh, the community had only rights to access, use and benefit from the commons, with no state-backed or legally recognized record. In Mala ka Khera, the community had additional rights to control how the commons is used and to exclude others from unauthorized use of the parcel, with legal backing for these rights. The open grazing land in Mukungarh had no dedicated committee with the specific responsibility to manage or oversee matters related to its use, whereas the closed grazing land in Mala ka Khera did.

For example, if governance of Mukungarh’s open grazing land improved to the same level of social capital as the closed grazing land in Mala ka Khera, according to the social capital model the valuation of the land would theoretically rise by $4,119/ha to $6,716/ha, 63% higher than it is currently.

Measuring Natural Capital

For each commons, the team asked villagers questions regarding the benefits and costs they derive or incur from mixed forest and pasture activities on the commons.

Among the six commons valued, the closed forestland (Veelva forest) in Udaipur was the most complex commons in which to conduct thorough bottom-up accounting, given its use by four different villages. Its forest ecosystem also proved more complex in its greater diversity of direct products available for local consumption and sale, compared to the commons in Bhilwara which are primarily used for fodder and fuelwood.

Findings. Community-based estimates of fodder and water provision on the closed grazing lands in Mala ka Khera and Mukungarh yielded higher Net Present Values (NPV) per hectare compared to the open grazing lands in the same villages. However, the valuations based on validated estimates of the closed grazing lands did not have consistently higher NPVs per hectare compared to the open grazing lands in the same villages. In Mala ka Khera in particular, validated estimates revealed that the closed grazing land had a lower valuation per hectare than the open grazing land, consistent with the greater reliance that communities reported on the open versus closed grazing land.
Closed grazing lands by nature are more regulated in terms of livestock access during certain periods of the year, whereas open grazing lands are less restrictive and more open access, which may lead to greater amount of fodder consumption in years where fodder productivity is still high. If the land becomes more degraded over time, fodder consumption could also fall as a function of the decreased availability of fodder productivity.

Beyond validation using FES data, Indufor benchmarked initial valuation results against market data on cropland values in Rajasthan using 99 Acres, India’s primary property portal, as well as Rajasthan’s District-Level Committee (DLC) rates. Although the valuation tool still requires adjustments to improve user-friendliness and accuracy, it is encouraging to see initial values within the range of market rates for land.

**Lessons Across Sites**

The following takeaways from field-testing are most salient for users of the tool or those broadly interested in valuing communally managed land:

1) **Free, prior, and informed consent and equitable representation and participation across villages who use a land parcel are key to ensure community buy-in and data quality.**

   NGOs and other facilitators should ensure that the use of the tool follows free, prior, and informed consent (FPIC) principles and stays true to community interests, sensitive to local conditions. In FES’s case, discussions were held with local communities prior to the valuation exercise to understand their perception of the idea of valuation on common lands and identify the key indicators they use to assess the value of their land. The meetings were used to also discuss other community affairs, all of which were documented in their village committee resolutions books, which both literate and nonliterate participants signed. FES framed the exercise as knowledge sharing between partners. There was a decision not to compel participation by offering compensation to participants for their time, but instead hold voluntary sessions.

   Efforts were made to interact with all of the communities across villages that used a specific commons parcel. For instance, Mukungarh Village in Bhilwara District consists of three habitations that are socially cohesive units in themselves and have varying levels of dependency on open and closed grazing land. Focused group discussions were held with the communities in all the three habitations to ensure thorough representation. At the same time, during the discussions it was also found that besides the three habitations within Mukungarh, people from three to four neighboring
villages also accessed and used the open grazing land. To produce mutually exclusive, collectively exhaustive answers in the limited timeframe, the team relied on one village to also estimate the number of livestock from neighboring villages that use the same commons. In the case of the Veelva forest in Udaipur, consultations were held with community members from all of the four villages who use the forest. Villagers were able to provide decent estimates on the benefits side, but less well positioned to estimate grazing-related labor costs incurred by other communities. For better results, NGO partners should work with all rather than just select communities using a parcel that they intend to value.

When field testing the tool, women’s participation was high in one village, and low in another. Although the need for equitable representation and participation across genders remains a priority, it can be difficult to implement given the limitations of how much an NGO can push the community on gender issues during short engagements.

In cases where the NGO has capacity to do so, do targeted outreach and event planning to ensure stronger turnout of underrepresented or marginalized people at meetings, across gender, caste level, socioeconomic class, age, and literacy level. In settings where there are entrenched customs segregating certain groups, it may be premature for the NGO to introduce this project, and may need more gradual measures first to build community capacity and buy-in.

2) Creative, locally appropriate survey methods are needed to improve rough estimates in rapid, community-deliberated settings.

It was hard to achieve consensus on certain group-deliberated averages, such as livestock holdings. Particularly in cases where there is greater variation from household to household, taking an average across a few vocal participants may not be accurate. Also, although people could provide livestock numbers before and after major intervals, it is hard to fill in the years in between because livestock numbers may rise or fall in drought years where cattle are sold off, and more generally as people’s income sources diversify.

Community members also did not have thorough recall of revenues and costs on a year-by-year basis, but provided answers in terms of an average good year and average bad year (e.g. as influenced by droughts or excessive rainfalls), and before-management and after-management (where management represents the establishment of village institutions to govern the commons). There is sometimes ‘time drift’ in answers.
Facilitators should use phrasings that ensure greater precision by anchoring community answers to specific, commonly agreed-upon points in time. It helps to have a community timeline, which graphically documents major events such as the closing of the forest, major droughts, or excessive rainfall. During survey efforts, referencing these points on paper can anchor community answers against consistent points in time. Surveyors may also need to ask additional questions, e.g. about how much livestock are typically sold in drought years, to inform follow-up math to attribute livestock numbers to specific years.

3) **Treatment of labor costs should factor in realistic assumptions about opportunity costs even if people are not being paid for their time.**

Initial versions of the valuation results applied daily National Rural Employment Guarantee Act (NREGA) rates to the total number of days that individuals per household spent grazing cattle and harvesting NTFPs. However, this assumption tends to overestimate actual labor costs, as some activities take less than the whole working day, and applying the NREGA rate may not realistically reflect the opportunity cost of individuals in the pilot areas. Some households’ alternatives would be to make a daily wage at NREGA or higher rates, while others may not.

For better estimates, users may switch to estimate daily opportunity cost by dividing average household income by the average number of working-age adults per household. They can also ask for the average number of numbers spent on each unpaid activity rather than applying the full daily rate.

4) **Validation of community-reported data is needed to adjust for errors.**

As illustrated earlier with fodder, validation of community-collected data was a recurring need. Net benefits derived from fodder were initially calculated based on group-deliberated figures on livestock head count broken down by livestock type, fodder requirements, and rough assumptions about the percentage of fodder requirements fulfilled by a specific land parcel versus other sources in different seasons. A general assumption that livestock need to consume about 2-3% of their body weight on a daily basis was applied across water buffalo, cattle, goats, and sheep. Despite considering these assumptions, total estimated fodder consumption was more than double the biophysical productivity of the land itself, the latter derived from biomass assessments. One possible explanation for the difference could be that people are also grazing their livestock on other patches aside from the two specific commons parcels.
Similarly, when the team sought to value the benefits of water provided by a local earthen pond on the commons, benefits of the earthen pond far exceeded the actual carrying capacity of the earthen pond when checked against FES data. It was necessary to validate community estimates and adjust the valuation accordingly with biomass survey and water carrying capacity data.

The tool is best used in areas where communities, local NGOs, or others have the capacity to validate data using past data, or to improve record keeping going forward.

5) **An income-based approach can represent the value currently derived by users from a land parcel, but cannot be misunderstood to represent a parcel’s full potential.**

People in Mukungarh have experienced a decline in livestock holdings as incomes diversify to include off-farm employment. It is unreasonable to assume that livestock numbers and fodder consumption will unconditionally rise when a community increases its social capital. The relationship between the land’s productive capacity and actual resource consumption depends on the broader context of land use and market dynamics. Even if the land becomes more productive, it might not be drawn upon for maximum sustainable yields. Community responses about resource consumption are therefore an unreliable proxy for the land’s productive capacity.

This lesson prompted a need to consider what adjustments to make for a more market-based approach that factors in potential productivity when feeding into a CAMA approach. Even if ecosystem services could be stronger under a less intensive harvesting regime, more technical methods needed to value ecosystem services may not always be feasible to carry out. Valuations weighed toward income-based data in areas rich with ecosystem services may underestimate value.

A technical rather than rapid, community-deliberated approach would generally be needed for a valuation approach based on land productivity. A community-based productivity approach could be used in select circumstances, though outside the scope of this tool currently. In Richwara, FES staff guided community participants to fill a fodder chart showing fodder volumes anchored by how much households can harvest each year. Because it covered annual grass fodder, it happened to roughly coincide with communities’ perception of overall productivity. For annual grass fodder or annual crops, community estimates of the quantity used can be used as rough proxies of productivity.

However, for perennial species, community estimates of the quantity used cannot be used as proxies of productivity. This issue of yield modeling for perennial species is an issue in both
grassland and forest ecosystems wherever fuelwood or other products are collected from perennial species. However, it is clearly much more problematic for forest ecosystems and perennial grasslands compared to annual grasslands. Granted, some selective accounting may be easier in forest ecosystems, depending on the system of harvest. For instance, in the case of the Veelva forest, the community cuts and carries the fodder from the forest, whereas for the commons used by Mukungarh and Mala ka Khera, fodder is grazed onsite by livestock. Cut-and-carry systems allow for simpler estimates of how much fodder is consumed from the forest compared to grazing-based production systems.

Tool users must therefore understand that the tool maintains a community-based consumption approach. They should take care to ask about multiyear harvest cycles rather than take averages across a couple years’ worth of convenient data. In a case where forest thinning for many years is punctuated by the occasional selective harvest, it would be important to be able to project that major harvest going forward, even if the community is only able to provide data on a couple of years with forest thinning activities. If the community has been managing the area long enough on a rotation, they should be able to provide more information.

Implementation of the bottom-up approach to rural land valuation yielded other valuable lessons and solutions on community engagement, as well as the underlying valuation methods and scope. They are summarized in Tables 9 & 10).

Scaling Up

After piloting the tool in Mukungarh and Mala ka Khera, initial results were shared and validated. A larger meeting was organized with about 100 people gathered from eight communities across the Kalyanpura Watershed in Bhilwara. The communities were excited to hear initial results about the value of benefits they derive from common lands, particularly the differences in value observed on managed versus unmanaged commons. Members from villages that were not a part of the initial pilot exercise were also keen to know the value of benefits being generated from the commons they used. For example, members of Nathji ka Khera at the meeting asked, “We have constructed an earthen pond and several check dams on our common lands. How much is the value of water that we are conserving?” Communities were particularly interested in assessing how their efforts to restore land and water resources were helping to improve the value of natural resources.
Following revisions of the tool, FES has expressed interest to use it in other areas to test the versatility of the tool. Communities in other states where FES is active such as Orissa would account for an even more diverse set of nontimber forest products given the greater complexity of their harvest activities in local forests.

FES expressed interest in using the valuation tool as a part of its standard toolbox of engagement with communities using revenue wastelands or other forms of commons. The valuation tool could be used together with decision-making tools such as the Composite Land Assessment and Restoration Tool (CLART), an FES tool developed to help communities plan local interventions around water recharge potential.

On a parcel-by-parcel basis, FES could use the valuation as part of a broader package to negotiate with government to strengthen collective tenure rights of local communities over common lands through legally binding arrangements, inform tradeoffs around diverting the parcel for other land uses, or provide an alternative compensation value in the case that a community may be displaced. In such a case, the valuation tool could be used to demonstrate valuation before and after management, or with poor versus strong tenure and other forms of social capital. FES is also interested in using the tool to help communicate the winners and losers associated with different land use scenarios.

FES also saw potential application of the tool in the context of meeting goals under countries’ Intended Nationally Determined Contributions frameworks. At a much larger scale, CAMA could estimate the value of commons across an entire state and be used to inform broader policymaking on commons. FES staff also expressed interest in using the tool in a decisionmaking exercise to explore different future scenarios based on different natural resource management and investment decisions. One such decision could be regarding the number and type of livestock that the community could rear such that they would maximize their returns from it while also managing the land sustainably. Such a tool could also help to facilitate intra-community negotiations over land use and related benefits.
Annex

Table 1: Examples of natural capital valuation approaches

<table>
<thead>
<tr>
<th>Intangible Natural Capital</th>
<th>Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecosystem services</td>
<td>Instrumental values: income approach or avoided cost approach&lt;br&gt;Intrinsic values: contingent valuation</td>
</tr>
<tr>
<td>Carbon sequestration</td>
<td>Carbon sequestration assessment, income approach using carbon market price data as benchmarks</td>
</tr>
<tr>
<td>Watershed services</td>
<td>Income approach using established payment-for-watershed-services rates as benchmarks&lt;br&gt;Economics modeling with empirical data of soil erosion effects</td>
</tr>
<tr>
<td>Biodiversity services</td>
<td>Instrumental values: income approach using mitigation banking, species banking, or other biodiversity offset prices as benchmarks; avoided cost approach;&lt;br&gt;Intrinsic values: contingent valuation</td>
</tr>
<tr>
<td>Recreational and spiritual value</td>
<td>Income approach using recreational or entrance fees as benchmarks&lt;br&gt;Travel cost method, contingent valuation, hedonic pricing</td>
</tr>
</tbody>
</table>

Figure 1: Remote Sensing Process and Flow Diagram
Table 2: Summary of existing tools comparison

<table>
<thead>
<tr>
<th>Tool</th>
<th>Quantifiable, approach to uncertainty</th>
<th>Time requirements</th>
<th>Capacity for independent application</th>
<th>Level of development documentation</th>
<th>Scalability</th>
<th>Generalizability</th>
<th>Nonmonetary &amp; cultural perspectives</th>
<th>Affordability, insights, integration with existing environmental assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESR</td>
<td>Qualitative</td>
<td>Low, depending on stakeholder involvement in the survey process</td>
<td>Yes</td>
<td>Fully developed and documented</td>
<td>Multiple scales</td>
<td>High</td>
<td>No valuation component</td>
<td>Most useful as a low-cost screening tool</td>
</tr>
<tr>
<td>InVEST</td>
<td>Quantitative, uncertainty through varying inputs</td>
<td>Moderate to high, depending on data availability to support modeling</td>
<td>Yes</td>
<td>&quot;Tier 1&quot; models fully developed and documented; &quot;Tier 2&quot; documented but not yet released</td>
<td>Watershed or landscape scale</td>
<td>High, though limited by availability of underlying data</td>
<td>Biophysical values can be monetized</td>
<td>Spatially explicit ecosystem service tradeoff maps; currently relatively time consuming to parameterize</td>
</tr>
<tr>
<td>ARIES</td>
<td>Quantitative, uncertainty through Bayesian networks and Monte Carlo simulation</td>
<td>High to develop new case studies, low for preexisting case studies</td>
<td>Yes, through web explorer or stand-alone software tool</td>
<td>Fully documented; case studies complete but global models and web tool under development</td>
<td>Watershed or landscape scale</td>
<td>Low until global models are completed</td>
<td>Biophysical values can be monetized</td>
<td>Spatially explicit ecosystem service tradeoff, flow, and uncertainty maps; currently time consuming for new applications</td>
</tr>
<tr>
<td>LUCI</td>
<td>Quantitative, currently does not report uncertainty</td>
<td>Moderate; tool is designed for simplicity and transparency, ideally with stakeholder engagement</td>
<td>Yes, through website is under development and more detailed user guidance is presumably forthcoming</td>
<td>Initial documentation and case study complete; follow up case studies in development</td>
<td>Site to watershed or landscape scale</td>
<td>Relatively high; a stakeholder engagement process is intended to aid in &quot;localizing&quot; the data and models</td>
<td>Currently illustrates tradeoffs between services but does not include valuation</td>
<td>Spatially explicit ecosystem service tradeoff maps; designed to be relatively intuitive to use and interpret</td>
</tr>
<tr>
<td>MIMES</td>
<td>Quantitative, uncertainty through varying inputs (automated)</td>
<td>High to develop and apply new case studies</td>
<td>Yes, assuming user has access to SIMILE modeling software</td>
<td>Some models complete but not documented</td>
<td>Multiple scales</td>
<td>Low until global or national models are completed</td>
<td>Monetary valuation via input-output analysis</td>
<td>Dynamic modeling and valuation using input-output analysis; currently time consuming to develop and run</td>
</tr>
<tr>
<td>EcoServ</td>
<td>Quantitative, uncertainty through varying inputs</td>
<td>High to develop new case studies, low for existing case studies</td>
<td>Yes, pending release of web explorer</td>
<td>Under development, not yet documented</td>
<td>Site to landscape scale</td>
<td>Low until global or national models are completed</td>
<td>Biophysical values can be monetized</td>
<td>In development, will offer spatially explicit maps of ecosystem service tradeoffs</td>
</tr>
<tr>
<td>CoString Nature</td>
<td>Quantitative</td>
<td>Low</td>
<td>Yes</td>
<td>Partially documented</td>
<td>Landscape scale</td>
<td>High</td>
<td>Outputs indexed, bundled ecosystem service values</td>
<td>Rapid analysis of indexed, bundled services based on global data, along with conservation</td>
</tr>
<tr>
<td>SoLVES</td>
<td>Quantitative, no explicit handling of uncertainty</td>
<td>High if primary surveys are required, low if function transfer approach is used</td>
<td>Yes, assuming user has access to ArcGIS</td>
<td>Fully developed and documented</td>
<td>Watershed or landscape scale</td>
<td>Low until value transfer can be shown to successfully estimate values at new sites</td>
<td>Nonmonetary preferences (rankings) of relative values for stakeholders</td>
<td>Provide maps of social values for ecosystem services; time consuming for new studies but lower cost for value transfer</td>
</tr>
<tr>
<td>Envision</td>
<td>Quantitative</td>
<td>High to develop new case studies</td>
<td>Yes</td>
<td>Developed and documented for Pacific Northwest case study sites</td>
<td>Landscape scale</td>
<td>Place-specific</td>
<td>Allows nonmonetary tradeoff comparison, also supports monetary valuation</td>
<td>Cost-effective in regions where developed; time consuming for new applications</td>
</tr>
<tr>
<td>EPM</td>
<td>Quantitative</td>
<td>High to develop new case studies, low for existing case studies</td>
<td>Yes, through web browser</td>
<td>Developed and documented for three case study sites</td>
<td>Watershed or landscape scale</td>
<td>Place-specific</td>
<td>Ecological, economic, and quality of life attributes could support nonmonetary valuation</td>
<td>Cost-effective in regions where developed; time consuming for new applications</td>
</tr>
</tbody>
</table>
**Table 3: Weights for Social Capital Survey Questions**

<table>
<thead>
<tr>
<th>Question Scope</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breadth of rights</td>
<td>20%</td>
</tr>
<tr>
<td>Legality of rights</td>
<td>20%</td>
</tr>
<tr>
<td>Security of land rights</td>
<td>15%</td>
</tr>
<tr>
<td>Institutions and rules</td>
<td>15%</td>
</tr>
<tr>
<td>Inclusivity and fairness</td>
<td>15%</td>
</tr>
<tr>
<td>Robustness of institutions</td>
<td>15%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100%</td>
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</table>

**Table 4: Scores for Social Capital Survey Answers**

<table>
<thead>
<tr>
<th>Answer</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>20</td>
<td>15</td>
<td>10</td>
<td>5</td>
<td>0</td>
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<tr>
<td>Score More than</td>
<td>Less than</td>
<td>Premium Rating</td>
<td>Spread</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>-----------</td>
<td>----------------</td>
<td>--------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.0</td>
<td>0.5</td>
<td>Ca</td>
<td>12.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5</td>
<td>1.5</td>
<td>Caa3</td>
<td>10.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td>2.5</td>
<td>Caa2</td>
<td>9.0%</td>
<td></td>
<td></td>
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<tr>
<td>2.5</td>
<td>3.5</td>
<td>Caa1</td>
<td>7.5%</td>
<td></td>
<td></td>
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<tr>
<td>3.5</td>
<td>4.5</td>
<td>B3</td>
<td>6.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.5</td>
<td>5.5</td>
<td>B2</td>
<td>5.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.5</td>
<td>6.5</td>
<td>B1</td>
<td>4.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.5</td>
<td>7.5</td>
<td>Ba3</td>
<td>3.6%</td>
<td></td>
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</tr>
<tr>
<td>7.5</td>
<td>8.5</td>
<td>Ba2</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>8.5</td>
<td>9.5</td>
<td>Ba1</td>
<td>2.5%</td>
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<td>Baa3</td>
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<td>13.5</td>
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<td></td>
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<td>14.5</td>
<td>15.5</td>
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<td>15.5</td>
<td>16.5</td>
<td>Aa3</td>
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<td></td>
</tr>
<tr>
<td>16.5</td>
<td>17.5</td>
<td>Aa2</td>
<td>0.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17.5</td>
<td>18.5</td>
<td>Aa1</td>
<td>0.4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.5</td>
<td>20.0</td>
<td>Aaa</td>
<td>0.0%</td>
<td></td>
<td></td>
</tr>
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</table>

Figure 2: Relationship between Direct Products and End Products

Table 6: Example CAMA Inputs Based on Simple Inputs
Table 7: Example CAMA Inputs Based on detailed GIS/Remote Sensing Analysis

<table>
<thead>
<tr>
<th>S.N.</th>
<th>Name of parcel</th>
<th>Type</th>
<th>Social capital from survey</th>
<th>Natural capital from survey</th>
<th>Area (ha)</th>
<th>Category based on RS</th>
<th>Coordinates (XY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>xxxx</td>
<td>Grassland</td>
<td>yyyy</td>
<td>zzzz</td>
<td>nnn</td>
<td>Poor</td>
<td>nn</td>
</tr>
<tr>
<td>2</td>
<td>xxxx</td>
<td>Forest</td>
<td></td>
<td></td>
<td>nnn</td>
<td>Poor</td>
<td>nn</td>
</tr>
<tr>
<td>3</td>
<td>xxxx</td>
<td>Wasteland</td>
<td>yyyy</td>
<td>zzzz</td>
<td>nnn</td>
<td>Medium</td>
<td>nn</td>
</tr>
<tr>
<td>4</td>
<td>xxxx</td>
<td>Grassland</td>
<td></td>
<td></td>
<td>nnn</td>
<td>Good</td>
<td>nn</td>
</tr>
<tr>
<td>5</td>
<td>xxxx</td>
<td>Forest</td>
<td></td>
<td></td>
<td>nnn</td>
<td>Medium</td>
<td>nn</td>
</tr>
</tbody>
</table>

Figure 3: Example Stand Variation Map

Table 8: Summary of Pilot Villages and Commons in Rajasthan, India
<table>
<thead>
<tr>
<th>District</th>
<th>Village</th>
<th>Shared commons</th>
<th>Legal classification</th>
<th>Land ownership</th>
<th>Ecosystem type</th>
<th>Values evaluated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bhilwara</td>
<td>Mukungarh</td>
<td>Open grazing land</td>
<td>Revenue wasteland</td>
<td>Revenue Department</td>
<td>Tropical semi-arid grassland</td>
<td>Fodder</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Closed grazing land</td>
<td>Pastureland</td>
<td>Gram Panchayat</td>
<td></td>
<td>Fuelwood</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Closed reserve forest*</td>
<td>Forestland</td>
<td>Forest Department</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Mala ka Khera</td>
<td>Open grazing land</td>
<td>Pastureland</td>
<td>Gram Panchayat</td>
<td></td>
<td>Fodder</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Closed grazing land</td>
<td>Pastureland</td>
<td>Gram Panchayat</td>
<td></td>
<td>Fuelwood</td>
</tr>
<tr>
<td></td>
<td>Mala ka Khera</td>
<td>Basbaada Mataji Temple</td>
<td>Sacred site</td>
<td></td>
<td></td>
<td>Spiritual (use)</td>
</tr>
<tr>
<td>Udaipur</td>
<td>Richwara</td>
<td>Closed forestland</td>
<td>Forestland</td>
<td>Forest Department</td>
<td>Tropical semi-arid forest</td>
<td>Fodder</td>
</tr>
<tr>
<td></td>
<td>Kyara ka Khet</td>
<td></td>
<td></td>
<td></td>
<td>Khakhra flowers</td>
<td>Khakhra seeds</td>
</tr>
<tr>
<td></td>
<td>Chitrawas</td>
<td></td>
<td></td>
<td></td>
<td>Behda bark</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sachariya</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* The Reserve forest in Bhilwara is excluded from pilot valuation efforts in October because it has been completely closed since 2011 and therefore the community cannot provide indicative data on revenues and costs.

Table 9: Observations and Lessons on Community Engagement from Pilot

<table>
<thead>
<tr>
<th>Complexity of data collection</th>
<th>Solutions and lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pilot observations</strong></td>
<td><strong>User-friendly visual anchors (e.g. community timeline, resource map) and follow-up math tables to help answer difficult valuation questions</strong></td>
</tr>
<tr>
<td><em>Limited recall</em>. Good community capacity to answer questions but limited to coarse averages, e.g. unable to recall revenue/cost data on a yearly basis</td>
<td>ankle anchor and anchor on time, e.g. good/bad years, before/after-management</td>
</tr>
<tr>
<td><em>Market access</em>. Some villages more connected with market than others, better equipped to provide market prices and other numerical estimates</td>
<td>Strong NGO partner and local Community Resource Persons that has cultivated trust and ideally has existing record of working with a community</td>
</tr>
<tr>
<td><em>Community support</em>. Community capacity to answer questions likely lower in similar rural communities without technical support from a key NGO partner or other institutions/individuals</td>
<td>User guide and training for facilitators</td>
</tr>
<tr>
<td><em>Android app</em>. The valuation survey, adapted for Android tablets, is catered to English and Hindi-literate users, and hard to fill onsite without follow-up math</td>
<td></td>
</tr>
</tbody>
</table>
### Harves/consumption methods
Some items hard to estimate regardless of education level (e.g., situations where fodder is consumed by livestock grazing directly on the land rather than via a cut-and-carry system)

### Harvest cycles
Sparse data on harvest cycles hinder accurate projections of revenues and costs for both grassland and forest ecosystems wherever fuelwood or other products are collected from perennial species; especially problematic for forest ecosystems and perennial grasslands

### Limited timing
Community members typically only available for two hours a day for two days on a voluntary basis making focus group discussions rushed. Sometimes unable to thoroughly go through all questions, categorically skipped investment outlay section

### Over/underestimation
Risks of double counting or overestimating amount of resource derived from a single parcel

### Accuracy of averages
Difficult to get consensus on average livestock counts when significant variation across households, particularly when only select community participants are vocal.

### Representation and participation

<table>
<thead>
<tr>
<th>Pilot observations</th>
<th>Solutions and lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Partner constraints.</strong> Representation limited to communities with which NGO partner has pre-existing relationships, making it more difficult to derive mutually exclusive, collectively exhaustive results if some but not all communities using a commons are represented</td>
<td>Importance of NGO partners to build relationships with all rather than just select communities using a parcel that they intend to value</td>
</tr>
<tr>
<td><strong>Gender and caste.</strong> Equal representation and participation varied between visits and between villages visited, most visible differences being between male and female engagement. Female and lower-caste participation has improved over the years, partly due to FES engagement</td>
<td>Equitable representation and participation across gender, caste level, socioeconomic class, age, literacy level, and leadership level crucial to ensuring equitable engagement and better triangulation of answers</td>
</tr>
<tr>
<td><strong>Community consent and ownership.</strong> FES made a deliberate decision not to compel participation by offering compensation to participants for their time, but rather to hold these sessions as optional events based on voluntary consent, with communities as partners</td>
<td>Free, Prior, and Informed Consent (FPIC) needed in advance of community use of tool</td>
</tr>
<tr>
<td><strong>Survey group size.</strong> Survey group size of 10-20 people meant fewer people able to actively speak and contribute during the discussion</td>
<td>Ways to ensure the survey process and use of the tool by communities is consensual without compulsion, adapted to local interests and culture</td>
</tr>
<tr>
<td><strong>Coordinated facilitation.</strong> Facilitators worked most effectively to guide community participants through the survey when delegated clear and non-redundant roles</td>
<td>Framing of sessions as knowledge-sharing opportunities and be proactive about returning to share results after data collection</td>
</tr>
<tr>
<td><strong>Coordinated facilitation.</strong> Facilitators worked most effectively to guide community participants through the survey when delegated clear and non-redundant roles</td>
<td>Balance struck between facilitators validating or guiding answers from community participants versus dominating the discussion at the expense of community participation</td>
</tr>
</tbody>
</table>
Table 1: Observations and Lessons on Valuation Tool Scope and Methods from Pilot

<table>
<thead>
<tr>
<th>General</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pilot observations</strong></td>
</tr>
<tr>
<td>• <strong>Defining community.</strong> A community is defined here as all households using a parcel, potentially encompassing one or more villages</td>
</tr>
<tr>
<td>• <strong>Community-centric approach.</strong> Many natural resource management activities are enabled through government grants; revenues from these are cancelled out by incurred costs so they net out at zero; other costs incurred by government may or may not be cancelled out by corresponding benefits</td>
</tr>
<tr>
<td>• <strong>Mixed land uses.</strong> In pilot areas, forest and grassland ecosystems were both used as mixed silvopasture systems, defying more rigid forestland and pastureland categorization</td>
</tr>
<tr>
<td>• <strong>Labor costs.</strong> Applying the NREGA rate as an estimate of daily opportunity cost is not sensitive to varying opportunity costs of individuals in pilot areas</td>
</tr>
<tr>
<td>• <strong>Low or negative Net Present Values.</strong> Valuation results may be lower/negative compared to expectations, sensitive to labor cost assumptions (e.g. if applying NREGA minimum wage rate)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Natural capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>• <strong>Flows vs. stocks.</strong> Net benefits captured in the valuation are falling in cases where an increasing number of households in a community diversify their livelihoods to include off-farm sources, even if overall land productivity remains high or increases</td>
</tr>
<tr>
<td>• <strong>Perennial species.</strong> For perennial species, community estimates of the quantity of consumption cannot be used as proxies for productivity given their longer-term harvest cycles, where the extent to which stocks are left standing between years affects growth rates and productivity</td>
</tr>
<tr>
<td>• <strong>Direct products vs. end products.</strong> Accounting for fodder, fuelwood, or water individually direct products rather than accounting for end products is easier from a data availability and quality standpoint, given limited community capacity to account for all end products, and interest in how much value is derived by the land itself rather than other inputs for value-added end products</td>
</tr>
<tr>
<td>• <strong>Tangible vs. intangible.</strong> Valuation of intangible forms of natural capital run into data gaps related to market pricing and quantification of natural capital supply itself, therefore incompatible with the current rapid community survey approach which relies on group-deliberated back-of-the-envelope estimates</td>
</tr>
<tr>
<td>• <strong>Direct vs. indirect.</strong> Valuation of indirect benefits of improved commons management such as increased crop yields due to enhanced water flows relies on a technical understanding of</td>
</tr>
</tbody>
</table>
hydrological flows in order to accurately attribute the relationship between commons and other parcels, incompatible with the rapid community survey approach

<table>
<thead>
<tr>
<th>Spiritual and cultural capital</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost-based approach.</strong> The current approach takes a conservative cost-based approach that does not capture the larger set of spiritual benefits. The number of hours spent at site may not be strongly correlated with the actual spiritual benefits obtained from the site</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Computer-assisted mass appraisal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Productivity overlay.</strong> Given the frequent disconnect between resource consumption and resource availability, an income-based approach does not reflect the full value of the land. Primary collection of productivity data can be costly</td>
</tr>
</tbody>
</table>
References


21 Ibid.

22 A discounted cash flow (DCF) is a valuation method used to estimate the attractiveness of an investment opportunity.


Built capital is defined as any pre-existing or planned formation that is constructed or retrofitted to suit human needs.