

Supplementary Information - Global networks of value capture in carbon credit projects

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S1 Organizational Roles

Table S1 Actor Role Definitions in Carbon Project Classification

Actor Role	Definition
Primary Sales	The entity holding original ownership of carbon credits generated by the project, with contractual rights to sell Verified Emission Reductions (VERs) or Certified Emission Reductions (CERs). Typically the project proponent or owner unless carbon rights have been contractually transferred.
Carbon Services	Organizations providing services related to carbon credit development, certification, and issuance, including preparation of Project Design Documents (PDDs), methodology development, baseline scenario development, MRV system design, registry coordination, and carbon-specific consulting services. Excludes physical implementation and third-party validation.
Operation	Entities responsible for on-the-ground project implementation and management, including coordination of physical activities (e.g., tree planting, agricultural practices), participant training, field data collection for monitoring, resource management, and day-to-day operational supervision.
Technology Provision	Organizations supplying or developing physical or digital technologies that support project activities, including Original Equipment Manufacturer (OEM) technologies, digital MRV applications, remote sensing services, and participant engagement platforms.
Registry & Standard	Carbon registries and certification standards under which projects are registered and certified (e.g., Verified Carbon Standard, Gold Standard, Plan Vivo). Excludes non-carbon environmental standards.
Validation & Verification	Independent third-party organizations that validate project compliance with carbon standards and verify reported emission reductions. These entities have no other involvement in the project.
Land Steward/Land Owner	Entities holding ownership, management authority, or long-term lease agreements for land on which the project is implemented, including government agencies, conservation organizations, private companies, or entities responsible for land title distribution.
Purchaser	Entities with contractual commitments to purchase carbon credits through offtake agreements, forward purchase contracts, or Verified Emission Reductions Purchase Agreements (VERPAs). Excludes non-binding expressions of interest.
Funder	Organizations providing financial resources through grants, loans, equity investments, or other financing mechanisms to support project development or operations, excluding carbon credit purchases. Includes financial institutions, development banks, and philanthropic organizations.
Research Partners	Research institutions, universities, or organizations conducting project-specific commissioned studies on non-carbon aspects such as biodiversity assessments, social impact evaluations, or feasibility studies. Excludes carbon methodology research, which falls under Carbon Services.
Other	Entities whose involvement does not fit defined categories, including general consulting, regulatory oversight, legal advisory services, or non-carbon certification. Used when no other classification applies and always assigned exclusively (not combined with other roles).

S2 PDD Details

Project Design Documents have different requirements and, therefore, different length. Figure S1 illustrates the length of PDDs in different registries.

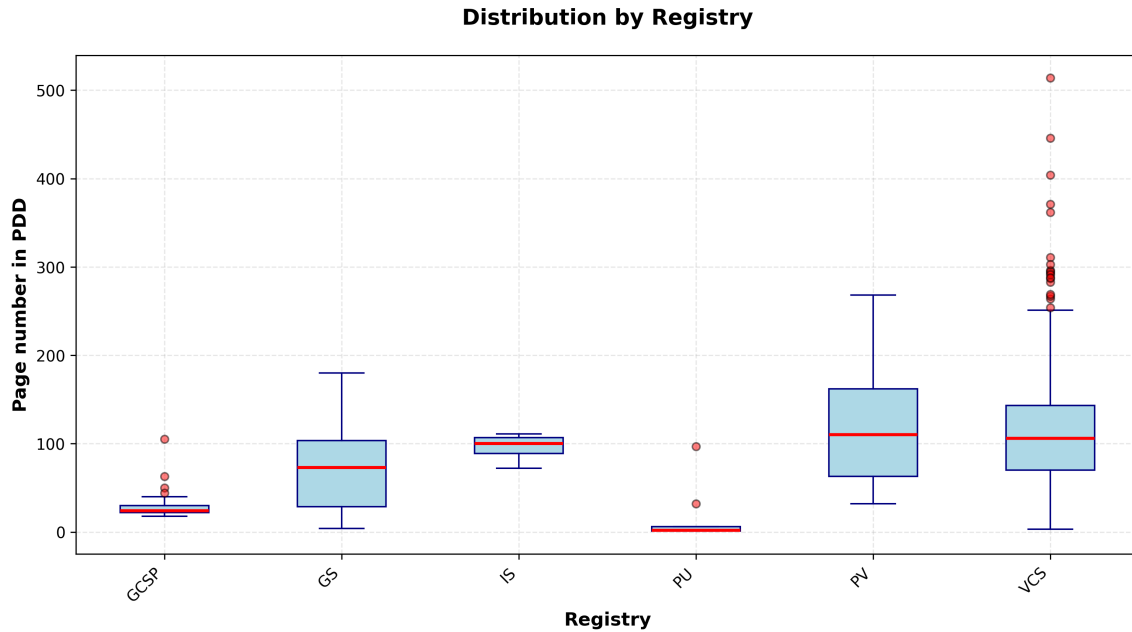


Fig. S1 Boxplots of PDD length by registry in pages. The box shows where the middle 50% of the data falls, spanning from the 25th percentile (bottom) to the 75th percentile (top). The red line marks the median page length. The whiskers extend to the most extreme data points that aren't considered outliers (further than 1.5 times distance of distance between 25th and 75th quartile).

S3 Validation

The validation procedure proceeds in two steps. First, two human coders independently extracted actors and value chains from ten project descriptions to establish intercoder reliability. Second, the output of the large language model was evaluated against human-coded ground truth from 30 projects, using the annotations of Researcher 1 (the principal investigator) where available as the reference. The distribution of projects across coders is reported in Table S2. Four natural language processing tasks are validated: (1) named-entity recognition of relevant actors, (2) multi-class classification of organizational roles, (3) named-entity recognition of impacted value chains, and (4) multi-class classification of value chain beneficiaries, land tenure (before and after) and interaction type.

Researcher 1	Researcher 2	Shared
GS12938	PU301704	VCS2928
PV15	VCS2609	VCS3447
VCS2647	PV16	GS3565
VCS2339	VCS3815	VCS3574
GS12323		GCSP1040
PV22		VCS4459
PU141608		GCSP1149
GCSP1084		VCS4898
GS5012		VCS3450
PV4		PU292788
VCS799		
VCS4329		
VCS3843		
GS11131		
GCSP1033		
PU226049		

Table S2 Project IDs for validation. Projects in the column "Shared" are coded by Researcher 1 and 2 to establish inter coder reliability. Researcher 1 is the principal investigator of this study.

S3.1 Intercoder Reliability

S3.1.1 Task 1: Named-entity recognition of relevant actors

For the named-entity recognition task, we computed the F1 score of the manually coded dataset, treating Researcher 1’s annotations as the reference. The resulting F1 score is 0.83 (precision = 1.00, recall = 0.74). Researcher 1 and 2 identified an overlapping set of 49 actors. Researcher 1 identified 14 actors that Researcher 2 did not identify, but Researcher 2 did not identify any actors that Researcher 1 did not identify. The main source of ambiguity in this task is the judgment of whether an actor plays an active role in the project. The most prominent actors are typically identified with high agreement, whereas more peripheral actors with narrower responsibilities lead to more disagreement.

S3.1.2 Task 2: Multi-class classification of organizational roles

Here, we validate the classification roles for actors that both coders identified. We report both the agreement between coders using Cohen’s κ to evaluate the degree to which agreement exceeds chance and the F1 score with researcher 1 assumed to code the ground truth. The F1 score is particularly meaningful for common roles like Carbon Services, Operations, or Carbon Rights Holders due to the small sample size of other roles. Cohen’s κ is 0.86, ranging between 0.72 and 1.0 between the roles, indicating very high agreement between coders, which is consistently high across classes (see table S3). The same applies for the F1 score with researcher 1 treated as the ground truth which consistently is above 0.8 across roles, with a weighted average of 0.88.

Table S3 Intercoder reliability for actor role classification across 35 actors. Cohen’s κ is reported alongside observed agreement and the number of positive assignments by each coder.

Role	Assigned by R1	Assigned by R2	Obs. agreement	Cohen’s κ
Carbon Services	12	11	0.914	0.806
Operations	15	18	0.857	0.715
Carbon Rights Holders	8	10	0.943	0.851
Land Steward	4	5	0.971	0.873
Technology Provision	2	3	0.971	0.785
Funder	1	1	1.000	1.000
Purchaser	0	0	-	-
Validation/Verification	4	4	1.000	1.000
Research Partner	1	1	1.000	1.000
Other	6	5	0.971	0.892

Table S4 Classification performance for actor role assignment for 35 actors, treating Researcher 1’s annotations as the reference. Precision, recall, and F1 are computed on the positive class only; support indicates the number of actors assigned each role by Researcher 1. The number of support is larger than 35, since one actor can have multiple roles.

Role	Precision	Recall	F1	Support
Carbon Services	0.91	0.83	0.87	12
Operations	0.78	0.93	0.85	15
Carbon Rights Holders	0.80	1.00	0.89	8
Land Steward	0.80	1.00	0.89	4
Technology Provision	0.67	1.00	0.80	2
Funder	1.00	1.00	1.00	1
Purchaser	-	-	-	0
Validation/Verification	1.00	1.00	1.00	4
Research Partner	1.00	1.00	1.00	1
Other	1.00	0.83	0.91	6
Weighted average	0.86	0.92	0.88	53

S3.1.3 Task 3: Named-entity recognition of impacted value chains

For the identification of impacted value chains, we again compute the F1 score against Researcher 1’s annotations. Researcher 1 identified 20 value chains across the ten shared projects, of which Researcher 2 also identified 19; one value chain was identified only by Researcher 1, and Researcher 2 additionally identified two value chains not flagged by Researcher 1. This yields a precision of 0.90, a recall of 0.95, and an F1 score of 0.93.

Researcher 2’s initial coding included both value chains directly impacted by project activities within the project area and value chains affected outside the project area, such as cases in which a project announces to distribute seedlings to surrounding villages as a positive social contribution. These value chains, that were more indirectly impacted by the carbon project were explicitly marked by researcher 2. For the validation, only value chains within the project area and directly impacted by project activities are considered, in line with the scope adopted by Researcher 1.

S3.1.4 Task 4: Multi-class classification of value chain beneficiaries

For the value chains identified by both coders, we validate the classification of four attributes: the beneficiary of the value chain, land tenure before the project, land tenure after the project, and the type of interaction between the project and the value chain. As in Task 2, we report Cohen’s κ to capture agreement beyond chance and the weighted F1 score with Researcher 1 as the reference. The results are summarized in Table S5.

The agreement is high for the classification of the tenure of the land after the project ($\kappa = 0.90$, weighted F1 = 0.97) and the type of interaction of the value chain between the project and the project ($\kappa = 0.92$, weighted F1 = 0.95), both well within the range conventionally interpreted as very high agreement. The agreement is lower for the beneficiary ($\kappa = 0.63$, weighted F1 = 0.73) and the tenure of the land prior to the project ($\kappa = 0.61$, weighted F1 = 0.78), where the coders arrive more frequently at different classifications. That makes sense, since land tenure and interactions with value chains are almost always explicitly stated in carbon project descriptions. The land tenure before the project and the beneficiary is often not explicitly stated and must be inferred from context. However, Cohen’s κ values indicate substantial intercoder agreement.

Table S5 Intercoder reliability for the multi-class classification of value chain attributes across 18 jointly identified value chains. Raw agreement, Cohen’s κ , and weighted F1 (with Researcher 1 as reference) are reported per attribute.

Attribute	Raw agreement	Cohen’s κ	Weighted F1	n
Beneficiary	0.778	0.625	0.734	18
Land tenure (before)	0.722	0.612	0.778	18
Land tenure (after)	0.944	0.899	0.969	18
Interaction	0.944	0.915	0.945	18

S3.2 LLM Validation

S3.2.1 Task 1: Named-entity recognition of relevant actors

Following the same approach as for intercoder reliability, we computed the F1 score of the LLM-extracted actors against the human-coded ground truth. The human coders identified 176 actors across the 30 project descriptions, of which 156 were also identified by the LLM. The remaining 20 were identified by the researcher only, while the LLM identified 30 additional actors not flagged by the researcher. This yields a precision of 0.84, a recall of 0.89, and an F1 score of 0.86, comparable to the agreement between the two human coders (see Section S3.1.1).

S3.2.2 Task 2: Multi-class classification of organizational roles

The agreement between the researchers and the LLM also reaches substantial levels for the role classification task, though slightly below the human-human agreement reported in Section S3.1.2. The pooled Cohen’s κ is 0.77, with per-role values ranging from 0.49 to 0.89, and the weighted F1 score is 0.81, with per-role F1 ranging from 0.50 to 0.90 (Tables S6 and S7). Performance is strongest for roles with clearly bounded criteria, such as Land Steward, Technology Provision, and Funder, and weaker for roles whose definitions allow more interpretive flexibility. The Purchaser role, with only two positive instances in the validation sample, yields unstable estimates and is not informative at this scale.

Among the focal roles, Carbon Services shows the lowest agreement ($F1 = 0.71$, $\kappa = 0.60$). Two sources of ambiguity drive this result. First, actors whose primary function is another role, for instance in Operations, sometimes take on isolated tasks that fall under Carbon Services, and the LLM and human coder disagree on whether these tasks justify the classification as Carbon Services. Second, the language in project descriptions is at times insufficiently specific about the exact tasks performed by each actor, leaving room for divergent interpretations even with a consistent codebook.

Table S6 Agreement between Human Coders and the LLM on actor role classification across all 156 jointly identified actors. Cohen’s κ is reported alongside observed agreement and the number of positive assignments by the researcher and the LLM.

Role	Assigned by Researcher	Assigned by LLM	Obs. agreement	Cohen’s κ
Carbon Services	39	43	0.846	0.603
Operations	56	62	0.872	0.728
Carbon Rights Holders	27	31	0.936	0.788
Land Steward	24	24	0.962	0.852
Technology Provision	9	11	0.987	0.893
Funder	17	14	0.968	0.821
Purchaser	2	6	0.974	0.490
Validation/Verification	9	12	0.981	0.847
Research Partner	4	7	0.981	0.718
Other	31	26	0.929	0.764

Table S7 Classification performance of the LLM for actor role assignment across 156 actors, treating the researchers’ annotations as the reference. Precision, recall, and F1 are computed on the positive class only; support indicates the number of actors assigned each role by the researchers. Support exceeds 156 because individual actors can be assigned multiple roles.

Role	Precision	Recall	F1	Support
Carbon Services	0.67	0.74	0.71	39
Operations	0.79	0.88	0.83	56
Carbon Rights Holders	0.77	0.89	0.83	27
Land Steward	0.88	0.88	0.88	24
Technology Provision	0.82	1.00	0.90	9
Funder	0.93	0.76	0.84	17
Purchaser	0.33	1.00	0.50	2
Validation/Verification	0.75	1.00	0.86	9
Research Partner	0.57	1.00	0.73	4
Other	0.88	0.74	0.81	31
Weighted average	0.79	0.84	0.81	-

S3.2.3 Task 3: Named-entity recognition of impacted value chains

For the LLM evaluation, we compute the F1 score of the LLM-extracted value chains against Researcher’s annotations across the 30 validation projects. The researchers identified 82 directly impacted value chains in total, of which the LLM also identified 68; 14 value chains were identified by the researcher only, while the LLM identified 18 additional value chains not flagged by the researcher. This yields a precision of 0.79, a recall of 0.83, and an F1 score of 0.81. The performance is lower than the human-human agreement on this task (F1 = 0.93, see Section S3.1.3), but remains in a range that supports the downstream analysis.

S3.2.4 Task 4: Multi-class classification of value chain beneficiaries

Agreement between the researchers and the LLM on the classification of value chain attributes follows a pattern broadly consistent with the human-human comparison (see Section S3.1.4). The interaction type is classified with the highest agreement ($\kappa = 0.89$, weighted F1 = 0.91), comparable to the human-human level on this attribute. Agreement on land tenure after the project ($\kappa = 0.75$, weighted F1 = 0.80) is lower than between human coders, while agreement on the more interpretive classes, beneficiary ($\kappa = 0.66$, weighted F1 = 0.91) and land tenure before the project ($\kappa = 0.69$, weighted F1 = 0.78), is at a similar level to the human-human comparison. Across all four attributes, κ remains in the substantial-agreement range and weighted F1 exceeds 0.77, supporting the use of the LLM-generated classifications in the downstream analysis.

Table S8 Agreement between researchers and the LLM on the multi-class classification of value chain attributes across 65 jointly identified value chains. Raw agreement, Cohen’s κ , and weighted F1 are reported per attribute.

Attribute	Raw agreement	Cohen’s κ	Weighted F1	n
Beneficiary	0.908	0.661	0.908	65
Land tenure (before)	0.800	0.686	0.776	65
Land tenure (after)	0.831	0.748	0.799	65
Interaction	0.923	0.889	0.909	65

S4 Calculation Examples Value Capture

S4.1 Overview

Here we present the back-of-the-envelop calculations of value share captured for Registries & Standards, presented in the main texts Table 1. For the estimation, we use two stylized projects: a small project issuing 10,000 tCO₂e per year and a large project issuing 1,000,000 tCO₂e per year. All figures are expressed in USD and assume a uniform credit price of USD 15/tCO₂e for ease of comparison.

S4.2 Registry fees

We used the fee schedule of Verra’s Verified Carbon Standard (VCS) as a representative benchmark for the voluntary carbon market, as Verra accounts for the majority of credits issued globally. According to Verra’s published fee schedule, project proponents pay an issuance fee composed of a fixed administrative component of USD 750 for annual registry fee, a USD 2,500 one-time registration review and USD 5,000 per verification

event (around once every five years). Assuming a project lifetime of 20 years, this leads to total fixed annual costs of USD 23,250 (annualized costs USD 1162.5) plus a variable component of USD 0.23 per credit issued (Verra 2024). The total registry fee per issuance was therefore calculated as:

$$\text{Registry fee} = 1,162.5 + (0.23 \times \text{number of credits issued}) \quad (\text{S1})$$

Gross revenue was calculated as the number of credits issued multiplied by the assumed price of USD 15/tCO_{2e}. The share of gross revenue absorbed by registry costs was then computed as:

$$\text{Share (\%)} = \frac{\text{annual costs}}{\text{annual gross revenue}} \times 100 \quad (\text{S2})$$

Input parameters and source attributions are summarised in Table S9, resulting cost components and revenue shares are reported in Table S10.

Table S9 Input parameters and data sources.

Parameter	Small project	Large project	Source
Annual credit issuance (tCO _{2e})	10,000	1,000,000	Illustrative
Carbon credit price (USD/tCO _{2e})	15	15	Illustrative
Annualized Verra fixed issuance fee (USD)	1163	1163	Verra (2024)
Verra variable issuance fee (USD/credit)	0.23	0.23	Verra (2024)

Table S10 Estimated cost components and share of gross revenue.

Cost component	Small project	Large project
Gross revenue (USD)	150,000	15,000,000
Verra registry fee (USD)	3463	231,163
Registry share of revenue (%)	2.3	1.5

S4.3 Projects by registry status

The largest category of projects are registered under a carbon registry and issue credits (Registered, Gold Standard Certified projects) with 38% (see Figure S2). A further 25.9% of projects have gone through validation and are waiting for approval by the registry (Registration requested, Registration and verification approval requested, Verification approval request, Gold Standard Certified Design). 32.5% of the projects are under validation.

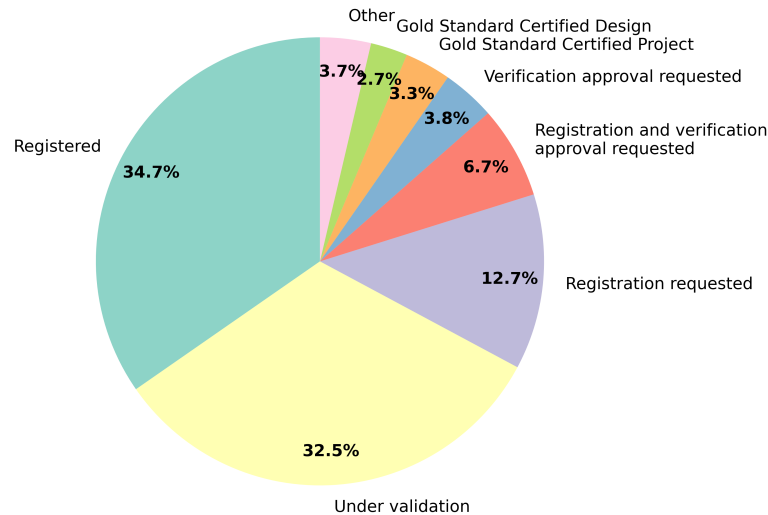


Fig. S2 Evaluated carbon projects by registry status.

S5 Value Chain Categories

The large language model is instructed to extract the value chain at the most granular level possible. To make results more comparable between projects and to reduce the sensitivity to overly granular project descriptions, we aggregate the value chains to larger categories. The categories are:

Food crop farming: subsistence farming, subsistence farming (beans), crops, wheat, corn, peanut, soybean, corn (maize), intercropping, intercropping (vegetables), winter wheat, summer corn, seasonal crops (wheat, cotton, corn, chickpeas), maize, rice, agriculture, agriculture/crops, Wheat, Paddy, paddy (rice), Intercropping (food crops), cassava, Maize, Corn, Beans and pulses, Rice, Intercropping (vegetables and legumes), beans, sorghum, barley, faba beans, jowar, groundnut, onion, green gram, gram, grams, millets, garlic, potato, paddy, Potato, groundnuts, millet, sweet potatoes, Seasonal crops (corn, cotton, wheat), crops (agriculture), upland rice, potatoes, peas, rye, arhar, cowpeas, root crops, black gram, yam, crops (various agricultural products), crops (various), rice/paddy, Rice/Paddy, cow peas, green grams, sweet potato, food crops, Beans, soy, subsistence farming (upland rice), soy/maize, peanuts, paddy field cultivation, ragi, red gram, Irish potatoes, agriculture (crops unspecified), agriculture (crops), chickpea, taro, crop cultivation (various crops including soybean, corn, oats, sorghum, fescue, clover, rye grass), tapioca, Mungbean, intercropping (cowpea, maize, peanut, cocoa), pulses, Subsistence farming, Subsistence farming (crop residues), manioc, organic food production, lentils, home garden.

Industrial crop farming: cotton, oilseeds, Sugarcane, sugarcane, Mustard, jute, sunflower, canola, sugar cane, tobacco, sesame, castor, rapeseed, Jatropha, Jatropha biofuel, rubber, Rubber (latex from Hevea brasiliensis), Rubber (latex), mustard, abaca, reforestation oil (pongamia), turpentine, Croton megalocarpus, arabic gum, resin, palm oil, oil palm, palm, coconut sugar production, patchouli.

Horticulture: fruits, black turmeric, fruit production, pomegranate, apple, olive, pineapple, Fruits (Lemon, Orange, Guava), citrus, Mango, Guava, fruit, guava, custard apple, orange, lemon, Jujube, Jackfruit, blueberries, Fruits (bananas, mangoes, avocados, passion fruit, citrus, papaya), fruit trees, papaya, avocado, jamun, jackfruit, Fruit production (avocados, apples, and other orchard crops), banana, coconut, litchi, cashew nuts,

apricot, fig, nuts, plantain, Bananas, Fruit, bananas, citrus (oranges), citrus (orange and lemon), lime production, Moringa, Macadamia, Avocado, Melons, Watermelons, Sweet potatoes, Potatoes, areca nut, nutmeg, fruits (mango, avocado, orange, cashew), Fruit production, hazelnut, horticulture (mango), horticulture (tamarind), horticulture (cashew), horticultural crops, durian, canarium nuts, vegetables, Vegetables (cabbage, kale, onions, tomatoes, etc.), horticulture, chilli, red chili, cashew nut, mango, cashew, macadamia, cocoa, tea, pepper, arecanut, spices (turmeric, ginger, black pepper), cacao, amla, reetha, tamarind, coffee, Coffee, Cocoa, Vanilla, vanilla, Brazil nut (chestnut), Açaí, Brazil nut (*Bertholletia excelsa*), cardamom, black pepper, betel nut, spices, cinnamon, clove, kava, gambir, baru nut, mushrooms, mushroom production, fungi, Coconut, mate herb, shea nut, Longan.

Livestock farming: livestock, livestock (cattle grazing), cattle ranching, livestock (cattle, sheep, goats), mohair wool, livestock (cattle, goat, sheep), livestock (cattle), livestock grazing, cattle grazing, livestock-/grazing, livestock/cattle ranching, beef cattle, livestock (camel and sheep), livestock (cattle and sheep), cattle/livestock, Grazing/Pasturing, livestock (sheep and goats), grazing/livestock, Livestock (cattle, goats, sheep, poultry), livestock (cattle, sheep, donkey, horse, camel), livestock (grazing), livestock (cattle, sheep, donkeys, horses, camels), livestock (cattle, sheep, horse), livestock (cattle ranching), livestock (cattle and buffalo), sheep (wool/meat), cattle ranching/livestock, livestock (sheep), livestock (goats), Livestock, dairy, livestock (cattle breeding), cattle/beef, dairy/milk, livestock/cattle grazing, Livestock/Pastoralism, Livestock grazing, livestock/rangelands, cattle, livestock (camel grazing), livestock (beef cattle), livestock (wool sheep), Cattle ranching (livestock), livestock (cattle, sheep, goats, camels, donkeys), animal husbandry, livestock (cattle ranching/pasture), livestock/pastoralism, dairy products, wool products, cashmere, livestock (goat and sheep), dairy farming, fodder, beef, cattle feed (pongamia seedcake/acrocomia pulp), cattle grazing/fodder collection.

Aquaculture and fisheries: Fisheries, fishing, oyster fishing, fish, aquaculture, fisheries, Fishing, crab farming, shrimp farming, crab, silvofishery, oysters, shrimp, shrimp aquaculture, aquaculture (fish/shrimp/crab ponds), shellfish, oyster, prawn seed collection, sea cucumber farming, seaweed farming, freshwater fish and prawns, Subsistence fishing.

Forestry: timber, bamboo, pulpwood, eucalyptus timber, timber plantation, timber (cedar and mahogany), Timber, Eucalyptus timber, Poplar timber, Teak timber, timber products from tending and managing, poles, timber (eucalyptus), rattan canes, poplar timber, mahogany, mangrove timber, invasive bamboo removal, tree products, bamboo (*Guadua angustifolia*), timber (teak), logging (nibung trees and timber), timber extraction, mangrove wood harvesting, *Melia volkensii*, *Moringa oleifera*, *Dalbergia melanoxylon*, illegal logging.

Non-timber forest products (NTFPs): Non-timber forest products (*Nypa* thatch), reed collection, non-timber forest products, non-timber forest products (NTFP), NTFP (Non-Timber Forest Products), rattan, forest products collection, African cherry (*Prunus africana*), Njangsa (*Ricinodendron heudelotii*), medicinal plants, medicinal extracts, traditional medicine, non-timber forest products (NTFPs), handicrafts, gathering, Copaiba oil, betel nut, Non-Timber Forest Produce (NTFP), Batana oil, frankincense, palm wine, Non-Timber Forest Products (NTFPs), non-timber forest products (NTFP) – wild honey, lac, betel vine, palm heart, copra.

Energy wood: firewood, firewood collection, Firewood, Firewood/Fuelwood, firewood/fuelwood, charcoal, Firewood collection, charcoal production, Charcoal, fuelwood, Fuelwood, fuelwood collection, mangrove charcoal production, encroacher bush clearing/charcoal.

Sericulture: Tasar silk (sericulture), sericulture (silk production), sericulture, sericulture (eri silk).

Apiculture: beekeeping, apiculture, beekeeping (honey), apiculture (honey/bee products), honey.

Agroforestry: agroforestry, agroforestry (mango), agroforestry (timber), agroforestry products (fruits, nuts, NTFPs), agroforestry (multiple crops), agroforestry/multipurpose tree products, agroforestry products.

Extractive industries: small-scale mining, gold mining.

Hunting: hunting, hunting (bushmeat), bushmeat, wild pig hunting, Subsistence hunting, hunting and gathering.

Soil improvements and inputs: vermiculture, seedlings, compost, bio-fertilizer, biochar, biochar/soil amendment, Biochar, biochar-based fertilizer, seedling production, Chinese milk vetch (green manure), seeds.

Other: no value chain, salt, eco-tourism, ecotourism, game farming/wildlife tourism, eco-print.

S6 Prompts

S6.1 Filter Images

We pass the following prompt together with an images to the large language model:

You are analyzing images from development project documents. The goal of the research is to identify economic and social aspects of carbon projects. You are prescreening images to determine if they are relevant to the research. Photographs of people and activities are typically not informative. Determine whether the image is relevant to the following research areas:

- Entities involved in the projects (e.g., companies, governments) AND what they are doing in the project (e.g. through organizational chart, diagrams, etc.)
- Information on employment, income, or livelihoods (e.g. through charts, newspaper articles,...)
- Agricultural value chains or market flows (e.g. through charts, diagrams, etc.)

Answer this checklist:

1. Does it include information on what organizations do in the project or how they are related? (Yes/No)
2. Does it include information on how people might profit from the project, like jobs, extra income, improvement of infrastructure, livelihoods? (Yes/No)
3. Does it contain information on how the project interacts with agricultural value chains or other local value chains? (Yes/No)

Then classify as: "RELEVANT" or "UNRELATED"

S6.2 Actor Prompt

To extract information about organizations in carbon projects the model receives this prompt alongside PDF text and pre-filtered images:

<objective>

Extract structured information about organizations involved in carbon projects from project descriptions (text and images). Follow a systematic chain-of-thought process to ensure accurate identification and classification of all project actors.

</objective>

<task_overview>

You will analyze a carbon project description document (60-120 pages) to identify all organizations with active roles in the project. Your analysis must follow a strict eight-stage process:

1. **Identification**: Find all organizations mentioned in the document. Use the organizations' names as they are presented in the text.
2. **Active Role Assessment**: Determine which organizations have active involvement
3. **Activity Extraction**: Document specific activities each actor performs
4. **Reasoning**: For every actor reason why you choose the roles and also argue why other roles that could fit were not chosen. You don't need to argue about clear cases.
5. **Role Classification**: Assign appropriate role(s) based on activities
6. **Location Identification**: Determine headquarters/location of each actor
7. **Subsidiary Relationships**: Identify parent organizations for subsidiaries from text
8. **Quality Checks**: Review for completeness and accuracy

Process both text and images systematically. Images may contain organizational charts, logos, contact information, or other relevant data about actors.

</task_overview>

<instructions>

<stage1>

Stage 1: Comprehensive Actor Identification

Task: Create an exhaustive list of ALL organizations mentioned in the document.

What to include:

- Companies (for-profit)
- Non-profit organizations and NGOs
- Government agencies and ministries
- Research institutions and universities
- Cooperatives and community organizations
- Validation/verification bodies
- Standards and registries
- Any other organized entities

What to exclude:

- Individual persons (unless they represent an organization, then include the organization name not the name of the person)
- Unorganized groups (e.g., "local farmers", "village residents", "field agents")
- Generic references (e.g., "local NGOs" without specific names)

<classification_process>

Process:

1. Read through the entire document systematically

2. Note every organization name, even if mentioned only once
3. Check images for additional organizations (logos, signatures, organizational charts, contact details)
4. Create a preliminary list with: organization name and page/section where mentioned

</classification_process>

****Output for Stage 1**:** List all organizations found with their mention locations.

<\stage1>

<stage2>

Stage 2: Active Role Assessment

****Task**:** Evaluate each identified organization to determine if they have an ACTIVE role in the project.

****Definition of Active Role**:**

An organization has an active role if they:

- Perform specific actions or tasks for the project
- Have contractual obligations or agreements with the project
- Provide services, technology, funding, or resources
- Perform stakeholder engagement or community engagement activities
- Make decisions affecting project implementation
- Hold rights or responsibilities (land rights, carbon rights, etc.)
- Create studies or research specifically for the project (e.g. environmental impact study commissioned for the project)

****Note**:** An entity can have multiple roles when they perform distinct functions (except for the category "Other", which is always exclusive when activities fit no other category)

****NOT Active Roles**** (exclude these):

- Only mentioned as stakeholders consulted during stakeholder consultation (i.e. not the organization conducting the stakeholder consultation). This does not change if they only provide input or feedback during consultations.
- Only listed as potential partners or under negotiation
- Only cited as sources of research/methodology (unless they conducted project-specific research)
- Only mentioned in passing or as examples
- Generic references without active participation (e.g., "discussed with local NGOs")
- Provide a study or report not specifically commissioned for the project

<classification_process>

****Process**:**

For each organization from Stage 1:

1. Review all mentions of the organization
2. Look for evidence of active involvement based on the definition above
4. Determine: Does this organization have an active role in the project?
5. If yes -> Keep for Stage 3
6. If no -> Note reason for exclusion

</classification_process>

```

**Output for Stage 2**:
- List of organizations WITH active roles (to proceed to Stage 3)
- List of organizations WITHOUT active roles (with brief exclusion reason)

<\stage2>
---
<stage3>
## Stage 3: Activity Extraction

**Task**: For each organization with an active role, extract ALL specific activities they perform
.

**What qualifies as an activity**:
- Concrete actions explicitly stated in the document
- Specific responsibilities or tasks assigned
- Services provided
- Deliverables mentioned
- Ongoing operational duties
- Having a carbon project specific role (e.g. project developer, CME, VPA implementer, project owner, project proponent etc.)

**Process**:
For each active organization:
1. Review every mention in the document
2. Extract direct quotes or paraphrase specific activities
3. List activities as action-oriented phrases (verb + object)
4. Be specific rather than generic (e.g., "Conducts monthly monitoring visits" rather than "involved in monitoring")
5. Check images for additional activity information

**Examples of good activity extraction**:
- "Prepares Project Design Documents"
- "Operates tree nurseries in 5 villages"
- "Provides dMRV mobile application"
- "Validates project against VCS v4.0"
- "Purchases 50,000 carbon credits annually under VERPA"

**Output for Stage 3**: For each actor, a comprehensive list of their specific activities.
<\stage3>
---
<stage4>
## Stage 4: Role Classification

**Task**: Based on the activities identified, assign appropriate role(s) to each actor.

Clear role definitions are:

<role_definitions>
  <role1>

```

1. Primary Sales:

The entity that holds the original ownership of the carbon credits generated by a project.

Primary Sales does not refer to the sale of other products or benefits from the project (e.g., timber, crops).

To evaluate Primary sales proceed in two steps:

Steps 1: Identify Carbon Rights Ownership:

- Look for explicit statements indicating which entity holds the carbon rights for the project.
- Check for contractual agreements, legal documents, or project descriptions that specify carbon rights ownership.
- Check if entity is the project proponent or project owner, as they often hold carbon rights.

Step 2: If carbon rights ownership is not explicitly stated, infer from context:

- If no other contractual agreement is stated in the document, assign carbon rights to the project proponent or project owner.

Key Indicators:

- The entity is contractually assigned the carbon rights.
- The entity is described as the legal owner of the project's Verified Emission Reductions (e.g., CERs, VERs)
- The entity is the project proponent or owner

Notes:

- Focus on carbon credit ownership and sales only, not broader project product sales.

<examples>

<example type="contractual_carbon_rights">

****Document text**:** "The Project Proponent is Company A, as stated in the PD, represented by John Doe. The Lease/Carbon Rights contracts, signed by the District, Village Council and Individual landowners, give the company the right to produce and sell carbon credits, and the CCROs assure the long-term security of the owner."

****Analysis**:**

- Company A is the project proponent
- Lease/Carbon Rights contracts explicitly give them "the right to produce and sell carbon credits"
- CCROs (Carbon Credit Rights Ownership) provide security
- Key phrase: "right to produce and sell carbon credits"

****Classification**:**

- actor_name: "Company A"
- role: "Primary Sales"
- reasoning: "Holds contractual carbon rights with explicit right to sell credits"

</example>

<example type="transferred_carbon_rights">

****Document text**:** "Subsequently, Company A has a contractual agreement with the lead project proponent, Company B, transferring the carbon rights of the project to Company B. This project development and project ownership agreement between Company A and Company B clearly states that the lead project developer, Company B is the legal owner of the project and of its Verified Emission Reductions 'VERs' under this cooperation throughout the agreement."

****Analysis**:**

- Carbon rights were transferred from Company A to Company B
- Company B is explicitly stated as "legal owner of the project and of its VERs"
- Transfer is contractual and documented
- Key phrase: "legal owner of...its Verified Emission Reductions"

****Classification**:**

- actor_name: "Company B" (not Company A)
- role: "Primary Sales"
- reasoning: "Legal owner of VERs after contractual transfer of carbon rights"

****Note**:** Company A would NOT be classified as Primary Sales since rights were transferred away

</example>

</role1>

<role2>

2. Carbon Services:

Services focused on the development, certification and issuance of carbon credits, excluding the physical implementation or operational management of carbon projects. This role encompasses only those activities necessary to navigate carbon standards, registries, methodologies and market requirements for the purpose of generating tradable credits. Often the project developer is responsible for Carbon Services. Activities include:

1. Pre-Project Assistance:

- Project identification
- Preparation of Project Design Documents (PDD)
- Feasibility studies related to carbon potential

2. Methodology Know-How:

- Development of carbon methodologies
- Baseline scenario development

3. Registration & Monitoring Design:

- Due diligence for project registration
- MRV (Monitoring, Reporting, and Verification) system design
- Assigning registration and issuance tasks
- Aggregating monitoring data to meet standard requirements (e.g. compiling field data into monitoring reports)
- Developing monitoring plans
- Coordination with carbon registries and standards bodies

4. Commercial Know-How related to carbon credits:
 - Commercial advisory services
 - Structuring of Emission Reduction Purchase Agreements (ERPAs)
5. Consultance on carbon credit project development.
 - Consulting services on any aspect of carbon credit project development if related to the above activities (e.g. technical advisor, strategic consultant...)

Notes:

****Critical Notes**:**

- Field data collection is classified under ****Operation****, not Carbon Services. However, aggregation of field data for preparing reports for the standard, registry or validator is a Carbon Service
- Managing the implementation of a project is ****Operation****, not Carbon Services
- Validation & Verification of project documents are ****not**** considered Carbon Services, but an independent role called ****Validation & Verification****
- Technical support, advising, consulting, or assistance is only counted as Carbon Service if it directly relates to activities around carbon credit development (as listed above), not if it relates to Operation activities
- It is not a Carbon Service if it relates to on-the-ground project activities, training of participants, or project operations
- Companies that only provide remote sensing data or technology in accordance with a methodology are considered ****Technology Provision****, not Carbon Services. If the company additionally consults with the carbon methodology, it is both Technology Provision and Carbon Services
- ****Preparing a Carbon Project Description document (the document you receive) is considered a Carbon Service activity****

<examples>

<example type="carbon_consulting_services">

****Document text**:** "Specialized services on climate change mitigation. Company A is involved with the design and development of the project and undertakes related services such as performing project baseline studies, designing and implementing monitoring plans and identification of project developers and sources of funding for projects."

****Analysis**:**

- Activities listed: design and development of climate change mitigation projects
- Specific carbon services: baseline studies, monitoring plan design
- These are pre-implementation, methodology-focused activities
- Key phrases: "baseline studies", "designing monitoring plans"

****Classification**:**

- actor_name: "Company A"
- role: "Carbon Services"
- activities: ["Performs project baseline studies", "Designs monitoring plans", "Develops climate change mitigation projects"]
- reasoning: "Provides carbon-specific consulting including baseline development and MRV design"

```

</example>

<example type="vcs_technical_advisor">
  **Document text**: "Organization name: Company A. Role in the project: Project
Proponent; VCS technical advisor and project partner responsible for VCS project development"

  **Analysis**:
  - Explicitly stated as "VCS technical advisor"
  - Responsible for "VCS project development"
  - VCS (Verified Carbon Standard) development is a carbon-specific activity
  - Key phrase: "responsible for VCS project development"

  **Classification**:
  - actor_name: "Company A"
  - role: "Carbon Services"
  - activities: ["VCS technical advising", "VCS project development"]
  - reasoning: "Explicitly responsible for carbon standard project development"
</example>

<example type="technical_support_ambiguity">
  **Document text**: "The project is a reforestation and afforestation initiative
designed and funded by Company A, with technical support from Company B, and implemented by
Company C."

  **Analysis**:
  - Company B provides "technical support"
  - Context: project is "designed" by A, "implemented" by C
  - "Technical support" in carbon project descriptions typically refers to carbon
methodology and development assistance, not on-ground implementation
  - Position between "designed" and "implemented" suggests development-phase
support. For company A it is unclear what design means. Further, more specific activities must be
assessed to decide if the "design" process is a carbon service or not.
  - Key phrase: "technical support" (in design context)

  **Classification**:
  - actor_name: "Company B"
  - role: "Carbon Services"
  - activities: ["Provides technical support for project development"]
  - reasoning: "Technical support in project descriptions usually refers to the
design of the carbon project according to the methodology and is, therefore, a carbon service."

  **Note**: If the text said "technical support for tree planting operations", this
would be **Operation** since it is explicitly about implementation work, not Carbon Services
</example>

<example type="document_preparation">
  **Document text**: "Document Prepared by Company A"

  **Analysis**:
  - Company A prepared the Project Description document

```

activity

- Preparing PDDs/project descriptions is explicitly listed as a Carbon Service

preparing it is always a carbon service

- You always get the project description document, therefore the organisation
- This is pre-registration work required for carbon certification
- Key phrase: "Prepared by"

```
**Classification**:  
- actor_name: "Company A"  
- role: "Carbon Services"  
- activities: ["Prepared Project Description Document"]  
- reasoning: "Preparing the project description document is a carbon service"  
</example>
```

```
<example type="cme_gold_standard">  
**Document text**: "Company A is the CME of the project"
```

services

```
**Analysis**:  
- CME = Coordinating/Managing Entity (Gold Standard terminology)  
- Under Gold Standard, the CME is responsible for project development and carbon

- This is a standardized role definition within Gold Standard framework
- Key phrase: "CME"

```

```
**Classification**:  
- actor_name: "Company A"  
- role: "Carbon Services"  
- activities: ["Serves as Coordinating/Managing Entity"]  
- reasoning: "The Coordinating/Managing Entity (CME) is responsible for project  
development and carbon services under Gold Standard"  
</example>
```

****Not**:** CMEs can additionally have the role "Operation" if activities indicate they are also implementing the project on the ground.

</role2>

<role3>

****3. Operation****

```
**Definition**:  
Involves managing project activities and conducting or coordinating activities directly on the ground related to carbon project execution. Operation is also often referred to as ** Implementation**. Operation activities are linked to the physical implementation of the carbon project.
```

```
**Scope**:
```

Includes tasks such as:

- Project implementation
- Local contracting
- Resource management
- Hiring and managing local personnel

- Coordination of on-the-ground activities like tree planting, agricultural practices, or conservation efforts
- Communication and coordination with project participants and local stakeholders
- Conducting participant training related to project activities
- Technical support for project activities (e.g. related to on-the-ground activities like tree planting or agricultural activities - not related to certification of carbon credit)
- On-the-ground data collection for monitoring purposes (e.g. field staff measuring tree growth, soil sampling)
- Organizing, supervising and executing project activities (e.g., logging, planting)
- Operating nurseries for seedling production
- Agricultural or timber value chain activities that are part of the project or directly linked to the project (e.g., training local community members, land management, agricultural/forestry practices)

****Critical Notes**:**

- Field data collection for Monitoring, Reporting and Verification (MRV) is ****Operation****. However, setting up the MRV plan is a ****Carbon Service****. Companies that provide a digital MRV system are considered ****Technology Provision****
- Operation is understood as an ongoing process. Single studies or reports, for example, on local communities or stakeholders that are commissioned by the project, are not considered Operations but ****Research Partners**** or support with land titling or other community work at the beginning of the project that is not ongoing are considered ****Other****.
- This role refers to the day-to-day operation of the carbon project, supervisory field visits or training plan development by carbon service providers are ****not**** Operation unless they are explicitly linked to on-the-ground project activities.

****Critical Note on Technical Assistance**:**

- "Technical assistance to farmers/participants" in field activities = ****Operation****
 - "Technical assistance" for carbon methodology/certification = ****Carbon Services****
 - If unclear, check context: Is it about growing trees/managing land (Operation) or about generating credits (Carbon Services), or both (Carbon Services AND Operations)?
- <examples>

<example type="project_implementation">

****Document text**:** "The Hongera Reforestation Project (Mt Kenya and Aberdares) is a reforestation and afforestation initiative designed and funded by Company A, with technical support from Company B, and implemented by Company C."

****Analysis**:**

- Three actors with distinct roles: designed, funded, supported, implemented
- Company C is explicitly the implementer
- Implementation = on-ground execution of project activities
- Key phrase: "implemented by"

****Classification**:**

- actor_name: "Company C"
 - role: "Operation"
 - activities: ["Implements reforestation and afforestation activities"]
 - reasoning: "Implementation of projects is an operational role"
- </example>

<example type="nursery_operations">
Document text: "... raised to viable seedling or sapling planting age (which is species-dependent) in nurseries established by Company A or the project."

****Analysis****:
- Company A establishes and operates nurseries
- Nurseries produce seedlings for planting
- This is on-ground physical project activity
- Key phrase: "nurseries established by"

****Classification****:
- actor_name: "Company A"
- role: "Operation"
- activities: ["Establishes nurseries", "Raises seedlings to planting age"]
- reasoning: "Operating nurseries for seedling production is an operational role"
</example>

<example type="training_activities">
Document text: "These activities will be conducted by local Company A members, who are trained by Company B technical specialists, supported by the Company C team and Company D advisors."

****Analysis****:
- Company B trains local members
- Training is for on-ground activities (not carbon methodology)
- This is participant capacity building for implementation
- Key phrase: "trained by...technical specialists"

****Classification****:
- actor_name: "Company B"
- role: "Operation"
- activities: ["Trains local company members", "Provides technical specialists for training"]
- reasoning: "Training of local community members for project activities is an operational role"

****Note****: Company C (support team) and Company D (advisors) may have Operation roles, but would need more detail about their specific activities. The activity here only clearly indicates Company B's does on the ground training.

</example>

<example type="vpa_implementer">
Document text: "Company A is the VPA implementer."

****Analysis****:
- VPA = Voluntary Program of Activity (Gold Standard terminology)
- VPA implementer is the local implementation entity
- This is the operational arm of Gold Standard projects

- Key phrase: "VPA implementer"

****Classification**:**

- actor_name: "Company A"
- role: "Operation"
- activities: ["Serves as VPA implementer"]
- reasoning: "Voluntary Program of Activity (VPA) implementer is the local implementer of Gold Standard projects"

<example type="dual_role_carbon_and_operations">
****Document text**:** "Company A prepared the PDD, handles certification, coordinates tree planting activities, trains local farmers, and conducts field monitoring visits."

****Analysis**:**

- PDD preparation and certification = Carbon Services
- Tree planting coordination, farmer training, field visits = Operation
- Same organization performs both types of activities
- Should receive BOTH roles

****Classification**:**

- actor_name: "Company A"
- roles: ["Carbon Services", "Operation"]
- activities: ["Prepared PDD", "Handles certification", "Coordinates tree planting", "Trains farmers", "Conducts monitoring visits"]
- reasoning: "Organization performs both carbon development services (PDD, certification) and operational implementation (field coordination, training)"

</examples>

</role3>

<role4>

4. Technology Provision:

****Definition**:**
 Supplying or developing a physical or digital technology that supports project activities.

****Scope**:**
 Includes activities such as:

- Developing or providing Original Equipment Manufacturer (OEM) technologies (e.g. biochar kiln, monitoring equipment, other machinery)
- Creating or supplying digital Monitoring, Reporting, and Verification (dMRV) applications or systems
- Remote Sensing - providing remote sensing data, services, or technology
- Providing technologies designed to incentivize participant engagement, like payment services or improved market access

- Other technological solutions relevant to the project development or operation
- Providing irrigation systems or other agricultural technologies that are not directly related to carbon credit generation but are part of the project activities

****Critical Notes**:**

- Technology Provision is recognized when the project ****actively uses**** the technology provided or developed by the actor
 - If a Carbon Service provider uses their self-developed dMRV system, they are classified as ****both**** Carbon Services ****and**** Technology Provision
 - Merely using or maintaining a dMRV system does not qualify as Technology Provision if another organization developed the system
 - Companies that purely do remote sensing but are not involved in other steps of the carbon certification are considered Technology Provision, ****not**** Carbon Services
 - ****IMPORTANT:** Running nurseries, producing seedlings, or providing planting material (seeds, saplings) is classified as OPERATION, not Technology Provision, unless it involves biotechnological innovation (e.g., GMO seeds, tissue culture labs, genetic improvement facilities)
- ****Traditional agricultural techniques, improved farming practices, or controlled management methods for seedling production are OPERATION activities, not Technology Provision****
- Technology Provision requires supplying a distinct technological product or system (equipment, software, machinery), not agricultural/forestry production activities

****Examples**:**

```
<example type="dmrv_system_developer">
**Document text**: "Company a is responsible for logging data into the ABC dMRV
system developed by Company A"
```

****Analysis**:**

- Company B developed the dMRV system
- The project uses this system (indicated by "logged into")
- dMRV (digital Monitoring, Reporting, and Verification) is a technology tool
- Company A only uses tool but has not developed it
- Key phrase: "developed by"

****Classification**:**

- actor_name: "Company B"
- role: "Technology Provision"
- activities: ["Developed ABC dMRV system"]
- reasoning: "Developed digital MRV technology actively used by the project"

****Note**:** If the text only said "the project uses the ABC dMRV system", Company A would NOT be extracted unless their active involvement is mentioned. Also don't extract dMRV system app names as actors, only the developer organization.

```
</example>
```

```
<example type="market_access_technology">
```

****Document text**:** "Benefits include a livestock-to-market mechanism provided by our commercial partner Company A. The MNP organizes mobile auctions that bring rural farmers and commercial buyers together; provides livestock management training for herders, NGOs, and farmers ; and organizes mobile abattoirs, enabling increased market opportunities for farmers and providing NGOs and farming communities with bulk purchasing power and access to critical farming equipment and vaccinations."

****Analysis**:**

- Company A provides a "livestock-to-market mechanism"
- This is a technology/platform that facilitates market access
- Includes mobile auctions and market organization infrastructure
- This technology incentivizes farmer participation in the project
- Key phrase: "mechanism provided by"

****Classification**:**

- actor_name: "Company A"
- role: "Technology Provision"
- activities: ["Provides livestock-to-market mechanism", "Organizes mobile auctions", "Provides market access platform"]
- reasoning: "Provides technology platform designed to incentivize participant engagement through improved market access"

****Note**:** The livestock management training mentioned could also suggest an ****Operation**** role, so Company A might have multiple roles depending on their full scope of activities

</example>

<example type="non_technology_provision">

****Counter-example - What is NOT Technology Provision**:**

****Document text**:** "The project uses the ForestTrack dMRV system for monitoring"

****Analysis**:**

- The project uses a dMRV system
- No mention of who developed it or active provider involvement
- Just stating usage of existing technology
- NO actor to extract

****Classification**:**

- No actor identified
- reasoning: "Simply using existing technology without identifying the provider or their active involvement does not create a Technology Provision actor"

</example>

</role4>

<role5>

****5. Registry & Standard****

****Definition**:**

The organization or system under which a carbon project is registered and certified.

****Scope**:**

We ONLY consider carbon standards and NOT consider standards for sustainable forestry or other environmental standards as carbon registries or standards - that falls under the category "Other". The role is only assigned to entities that are responsible for the registration and certification of carbon credits. This includes:

- Carbon registries
- Carbon standards

****Involved Standards**:**

- Verified Carbon Standard (VCS)
- Gold Standard
- Carbon Standards International
- Plan Vivo
- Puro
- Isometric

****Critical Notes**:**

- If a standard or registry other than those listed above is referenced, confirm carefully that it is indeed acting as a Registry or Standard before assigning this role
- Focus only on entities responsible for certifying, issuing, or overseeing carbon credit registration and verification

****Examples**:**

<example type="registry_identification">

****Document text**:** "Carbon Registry: Registry A"

****Analysis**:**

- Explicitly labeled as the carbon registry
- This is the system where credits are registered and tracked
- Key phrase: "Carbon Registry:"

****Classification**:**

- actor_name: "Registry A"
- role: "Registry & Standard"
- activities: ["Serves as carbon registry for the project"]
- reasoning: "Explicitly identified as the carbon registry"

</example>

<example type="non_carbon_standard">

****Counter-example - What is NOT Registry & Standard**:**

****Document text**:** "The project adheres to FSC (Forest Stewardship Council) standards for sustainable forestry"

```

**Analysis**:
- FSC is a forestry certification standard, not a carbon standard
- This relates to timber/forestry practices, not carbon credit certification
- Should be classified as "Other" if FSC has an active role

**Classification**:
- actor_name: "Forest Stewardship Council"
- role: "Other" (NOT Registry & Standard)
- reasoning: "FSC is a forestry standard, not a carbon registry or carbon
certification standard"
</example>
</role5>

```

```
<role6>
```

```
**6. Validation & Verification**
```

```

**Definition**:
Validation & Verification Bodies. These are always third-party organizations that are
not involved in the project otherwise.

```

```
**Examples**:
```

```

<example type="validation_statement">
**Document text**: "Company A has validated that the project Udzungwa Corridor
Reforestation is in compliance with the Verified Carbon Standard version 4 and the CCB Standards"

```

```
**Analysis**:
```

- Company A performed validation
- Validation confirms compliance with VCS and CCB standards
- This is third-party assessment activity
- Key phrase: "has validated that"

```
**Classification**:
```

```

- actor_name: "Company A"
- role: "Validation & Verification"
- activities: ["Validated project against VCS version 4", "Validated project against
CCB Standards"]
- reasoning: "Third-party validator confirming project compliance with carbon
standards"
</example>

```

```
<example type="validation_body_contact">
```

```

**Document text**: "Validation Body: Company A, 2000 Powell Street, Ste. 600,
Emeryville CA 94608 USA, www.SCSglobalServices.com"

```

```
**Analysis**:
```

- Explicitly labeled as "Validation Body"
- Contact information provided for the validator
- Key phrase: "Validation Body:"

```

    **Classification**:
    - actor_name: "Company A"
    - role: "Validation & Verification"
    - activities: ["Serves as validation body"]
    - headquarter: "Emeryville, USA"
    - reasoning: "Explicitly identified as the validation body"
  </example>
</role6>

```

<role7>

****7. Land Steward/land owner****

****Definition**:**

The entity that owns, manages, or holds responsibility for the land on which the project is implemented. This can include ownership with or without a direct economic interest in the land or long-term land lease agreements or concessions. The entity can decide on land use and management practices, including carbon project implementation and operation.

****Scope**:**

Includes:

- Ministries or government agencies
- Conservation NGOs
- Private companies
- Any entity holding land titles or responsible for distributing land titles

****Critical Notes**:**

- Entities that own the land are ****always**** assigned the Land Steward/Land Owner role, regardless of their level of economic involvement
- Stewardship can involve either direct land ownership, concession rights, or administrative control over land title distribution
- There can be ****two entities**** with role "Land Steward/land owner", for example if one entity owns the land and another entity leases the land

****Examples**:**

<example type="land_management">

****Document text**:** "Company A is the implementing agency managing the 2,474,700 ha (UNESCO) Kruger to Canyons biosphere reserve since 2001. Organisation A is currently running 12 projects with partners in the biosphere linking sustainable development and biodiversity conservation including expansion of protected areas and sustainable land management"

****Analysis**:**

- Company A manages 2.4 million hectares
- Has authority over land use decisions
- Manages protected areas and land management
- Key phrase: "managing...biosphere reserve"

```
**Classification**:
- actor_name: "Company A"
- role: "Land Steward/land owner"
- activities: ["Manages 2,474,700 ha biosphere reserve", "Oversees sustainable land
management"]
- reasoning: "Management authority over the land on which the project is implemented"
</example>
```

```
<example type="dual_land_stewardship">
```

```
**Document text**: "Company B has a 50 year leasing agreement with the Ministry A"
```

```
**Analysis**:
```

- Ministry A owns the land (can lease it out)
- Company B has long-term lease (50 years)
- Both have land stewardship roles: owner and lessee
- Key phrase: "leasing agreement"

```
**Classification**:
```

- actor_name: "Company B"
- role: "Land Steward/land owner"
- activities: ["Holds 50-year lease on project land"]
- reasoning: "Long-term lessee with control over land use"

- actor_name: "Ministry A"
- role: "Land Steward/land owner"
- activities: ["Owns land leased to project"]
- reasoning: "Land owner who granted long-term lease"

```
**Note**: Both entities are assigned Land Steward/land owner role as they both have
stewardship responsibilities
```

```
</example>
```

```
</role7>
```

```
<role8>
```

```
**8. Purchaser**
```

```
**Definition**:
```

```
Entities that have committed to purchasing carbon credits from the project through
contractual agreements.
```

```
**Scope**:
```

```
Purchase types include:
```

- Long-term offtake agreements
- Forward purchase contracts for carbon credits
- Contractual commitments to buy specific volumes of credits
- Credit purchase agreements with defined terms
- Supports the project to offset their emissions or as part of their sustainability
strategy

****Critical Notes**:**

- Focus on entities that have ****contractual commitments**** to buy carbon credits or to offset emissions through the project
- The purchase agreement must be secured, committed, or guaranteed. Mere expressions of interest, letters of intent, or even negotiations in advanced stages do ****not**** qualify
- Distinguish from general project funders - Purchasers specifically buy the carbon credits as the project's output

****Examples**:**

<example type="multiple_offtakers">

****Document text**:** "Company A's audit team accessed the three VERPAs (Verified Emission Reductions Purchase Agreements) signed with the following off-takers: Company B, Company C, Company D."

****Analysis**:**

- VERPAs = contractual agreements to purchase carbon credits
- Three entities have signed agreements (not just negotiating)
- These are committed purchases of carbon credits specifically
- Key phrase: "VERPAs signed with"

****Classification**:**

- actor_name: "Company B"
 - role: "Purchaser"
 - activities: ["Signed VERPA to purchase carbon credits"]
 - reasoning: "Has committed offtake agreement to purchase carbon credits"

 - actor_name: "Company C"
 - role: "Purchaser"
 - activities: ["Signed VERPA to purchase carbon credits"]
 - reasoning: "Has committed offtake agreement to purchase carbon credits"

 - actor_name: "Company D"
 - role: "Purchaser"
 - activities: ["Signed VERPA to purchase carbon credits"]
 - reasoning: "Has committed offtake agreement to purchase carbon credits"
- </example>

<example type="forward_purchase_agreement">

****Document text**:** "Company H has signed a forward purchase agreement to acquire 100,000 VERs annually from the project over 10 years"

****Analysis**:**

- Forward purchase agreement = contractual commitment
- Specific volume and timeframe defined (100,000 VERs annually, 10 years)
- This is purchasing carbon credits as output
- Key phrase: "signed a forward purchase agreement"

```

    **Classification**:
    - actor_name: "Company H"
    - role: "Purchaser"
    - activities: ["Committed to purchase 100,000 VERs annually under forward purchase
agreement"]
    - reasoning: "Has contractual commitment to purchase carbon credits over defined
period"
  </example>

  <example type="offtake_agreement">
    **Document text**: "The project has secured an offtake agreement with Company I for all
credits generated in Phase 1"

    **Analysis**:
    - Offtake agreement = purchase commitment for project output (credits)
    - Agreement is secured (not potential or under negotiation)
    - Covers all credits from Phase 1
    - Key phrase: "secured an offtake agreement"

    **Classification**:
    - actor_name: "Company I"
    - role: "Purchaser"
    - activities: ["Secured offtake agreement for Phase 1 carbon credits"]
    - reasoning: "Committed to purchasing carbon credits through secured offtake agreement"
  </example>

  <example type="emission_offsetting_commitment">
    **Document text**: "Company K support the project financially as part of their
sustainability strategy"
    - role: "Purchaser"
    - activities: ["Supports project to offset emissions through financial commitment"]
    - reasoning: "A company that supports carbon projects financially as part of their
sustainability strategy is considered a Purchaser since they likely intend to use the credits to
offset their emissions"
  </example>

  <example type="non_committed_purchase">
    **Counter-example - What is NOT Purchaser**:

    **Document text**: "Company J has expressed interest in purchasing carbon credits from
the project"

    **Analysis**:
    - "Expressed interest" = not yet committed
    - Does not meet the "secured, committed, or guaranteed" requirement
    - NO actor to extract

    **Classification**:
    - No actor identified

```

- reasoning: "Purchase discussions, even if promising, do not qualify until contractual commitment is secured"

</example>

</role8>

<role9>

****9. Funder****

****Definition**:**

Entities that have committed financial resources to support project development, implementation, or operations through grants, investments, loans, or other financing mechanisms (excluding carbon credit purchases).

Typically those are financial institutions, development banks, philanthropic organizations, government agencies, or private sector investors.

****Scope**:**

Funding types include:

- Grant funding (non-repayable financial support)
- Loans (debt financing)
- Direct equity investment into the project
- Initial financing of project equipment or infrastructure
- Initial financing for project development or pilot phases
- Development finance
- Philanthropic funding
- Blended finance arrangements
- common trigger word is "investests in", "provides funding for", "finances", "grants", "co-funder", "backer", "supports financially"
- managing the finances of the project is NOT necessarily being a funder, unless it is clear that the funds come from the entitiy

****Critical Notes**:**

- Focus on entities providing financial resources that enable project development or operation
 - The funding must be secured, committed, or guaranteed. Mere expressions of interest or even funding proposals or negotiations in advanced stages do ****not**** qualify
 - Distinguish from Purchasers - Funders provide capital/grants, while Purchasers buy carbon credits
 - An entity is either a Funder or a Purchaser, since if they are interested in buying credits or offsetting emisisions, they are purchasers.

****Exclusion****

- Company plans to pruchase Credits -> this is Purchaser, not Funder
- Company plans to offset emission through project -> this is Purchaser, not Funder

****Examples**:**

<example type="grant_funding">

****Document text**:** "Company A is a co-funder to CSA for the Pro-Nature Enterprises Project"

****Analysis**:**

- Company A provides funding (co-funder)
- This is committed funding for the project
- No mention of credit purchase - this is capital support
- Key phrase: "co-funder"

****Classification**:**

- actor_name: "Company A"
 - role: "Funder"
 - activities: ["Co-funds the project"]
 - reasoning: "Provides committed funding to support project implementation"
- </example>

<example type="project_investment">

****Document text**:** "Company E is an investor in the project"

****Analysis**:**

- Company E has invested in the project
- Investment = financial commitment (likely equity)
- Not purchasing credits, but providing capital
- Key phrase: "investor in"

****Classification**:**

- actor_name: "Company E"
 - role: "Funder"
 - activities: ["Invested in the project"]
 - reasoning: "Provides direct equity investment into the project"
- </example>

<example type="equipment_financing">

****Document text**:** "The project equipment is financed by Company F"

****Analysis**:**

- Company F finances equipment
- Equipment financing enables project implementation
- This is capital provision, not credit purchase
- Key phrase: "financed by"

****Classification**:**

- actor_name: "Company F"
 - role: "Funder"
 - activities: ["Finances project equipment"]
 - reasoning: "Provides financing for project equipment and infrastructure"
- </example>

<example type="development_grant">

****Document text**:** "Organization A provided a \$2 million grant for project development and community engagement activities"

****Analysis**:**

- Organization A provides grant funding
- Grant = non-repayable financial support
- Funds are for development and operations, not credit purchase
- Key phrase: "provided a...grant for"

****Classification**:**

- actor_name: "Global Environment Facility"
 - role: "Funder"
 - activities: ["Provided \$2 million grant for project development and community engagement"]
 - reasoning: "Committed grant funding to support project development"
- </example>

<example type="dual_role_funder_and_purchaser">

****Example - Entity with both Funder and Purchaser roles**:**

****Document text**:** "Company M provided \$1 million in seed funding for project development and has also signed a VERPA to purchase 200,000 credits over 5 years"

****Analysis**:**

- Company M provides upfront funding (\$1 million)
- Company M also has credit purchase commitment (VERPA)
- Two distinct financial relationships with the project
- Key phrases: "provided...funding" AND "signed a VERPA"

****Classification**:**

- actor_name: "Company M"
 - roles: ["Funder", "Purchaser"] (BOTH roles)
 - activities: ["Provided \$1 million seed funding", "Signed VERPA to purchase 200,000 credits"]
 - reasoning: "Acts as both Funder (seed capital) and Purchaser (credit offtake agreement)"
- "

</example>

<example type="non_committed_funding">

****Counter-example - What is NOT Funder**:**

****Document text**:** "The project is in advanced negotiations with Company G for funding of \$3 million"

****Analysis**:**

- "Advanced negotiations" = not yet committed
- Does not meet the "secured, committed, or guaranteed" requirement
- NO actor to extract

****Classification**:**
- No actor identified
- reasoning: "Funding negotiations, even if advanced, do not qualify until commitment is secured through signed agreements"
</example>

</example>
</role9>

<role10>

****10. Research partners****

****Definition**:**
Research institutions, universities, or NGOs that conduct research or provide studies directly for the project that are not specifically related to carbon credit development or carbon credit methodologies.

****Scope**:**
Includes:
- Conducting feasibility studies or environmental/social impact studies that are important for the project's development but not directly tied to carbon credit methodologies
- Providing baseline studies with the primary focus on non-carbon-related aspects like biodiversity studies, or socio-economic assessments.
- General scientific or technical research aimed at understanding or supporting the project context, but not specific to carbon measurement or crediting
- Social assessments, community impact studies, or other research that informs project design or implementation but does not focus on carbon credit methodologies

****Excludes**:**
- Studies with the primary focus on carbon quantification or carbon baselines which are part of ****Carbon Services****
- If the research is primarily focused on developing or supporting carbon credit methodologies (e.g., GHG emissions modelling), this falls under ****Carbon Services****, not Research Partners

****Critical Notes**:**
- Research Partners are only considered actors if they conduct studies ****specifically commissioned for the project****
- If an organization is cited for their published research in a general sense but is not directly involved in the project, they are ****not**** considered a Research Partner

****Examples**:**
<example type="project_specific_study">
****Document text**:** "The project proponent issued a study with University A on the social implications of the project"

```

**Analysis**:
- University A conducted a study specifically for this project
- The study focuses on social implications (not carbon methodology)
- This is project-specific commissioned research
- Key phrase: "issued a study with"

**Classification**:
- actor_name: "University A"
- role: "Research partners"
- activities: ["Conducted study on social implications of the project"]
- reasoning: "Conducted project-specific research on non-carbon aspects (social impact
assessment)"
</example>

<example type="carbon_research_not_research_partner">
**Counter-example - What is NOT Research Partners**:

**Document text**: "The project used University B's methodology for carbon stock
estimation, as published in Smith et al. (2020)"

**Analysis**:
- University B's research is cited, but they didn't conduct project-specific research
- This is use of published methodology, not commissioned work
- Carbon stock estimation methodology = Carbon Services domain
- NO actor to extract since they are not directly involved in the project

**Classification**:
- No actor identified
- reasoning: "Citing published research does not make the institution a Research Partner;
they must conduct project-specific commissioned research"
</example>

<example type="biodiversity_assessment">
**Document text**: "Research Institute C was contracted to conduct a biodiversity
baseline assessment for the project area"

**Analysis**:
- Institute C was contracted (project-specific work)
- Biodiversity assessment is non-carbon research
- This informs project design but isn't carbon methodology
- Key phrase: "contracted to conduct"

**Classification**:
- actor_name: "Research Institute C"
- role: "Research partners"
- activities: ["Conducted biodiversity baseline assessment"]
- reasoning: "Project-commissioned biodiversity research not related to carbon credit
methodologies"
</example>
</role10>

```

<role11>

****11. Other****

****Definition**:**

This role is for entities whose involvement in the project does not clearly fit into any of the previously defined roles. It serves as a catch-all category for undefined or unclear roles that do not directly relate to project implementation or carbon services.

****Scope**:**

Only use this category if the actor does not fit any other category. It includes:

- Entities ****only**** providing general consulting or approval for the project (e.g., a government agency providing oversight but not actively engaged in project implementation)
- Entities ****only**** involved in community engagement or community well-being activities not explicitly tied to training for project implementation (if not directly involved in training, this would fall under Operation)
- Entities ****only**** providing legal advice
- Standards or verifiers that are not related to carbon credits (e.g., environmental standards, forestry standards, organic standards)

****Excludes**:**

- If an entity is already categorized under one of the other roles (e.g., Land Steward, Carbon Services, Operation), do ****not**** add "Other" as an additional role for the same entity
- The role "Other" is ****always the only role**** for actors that do not fit into another category
- Roles that are directly related to carbon credit generation or project operations (those should be categorized appropriately under Carbon Services, Operation, etc.)

****Critical Notes**:**

- This serves as a miscellaneous category, but should ****not be overused**** when an entity clearly fits within another role
- Use "Other" sparingly - most actors should fit into one of the specific categories
- Only use "Other" when no other activity fits into other roles. Do not use it if another role applies and then only use it alone. Entities that are "Other" cannot have multiple roles.

****Examples**:**

<example type="government_oversight">

****Document text**:** "Government Agency A providing consultation or approval for the project without having a defined role in implementation."

****Analysis**:**

- Government Agency A provides consultation/approval
- No active implementation role described
- Not land owner, not funder, not operator
- This is regulatory oversight, which doesn't fit other categories
- Key phrase: "providing consultation or approval"

```

**Classification**:
- actor_name: "Government Agency A"
- role: "Other"
- activities: ["Provides consultation and approval for the project"]
- reasoning: "Government oversight and approval role that does not fit other categories"
</example>

<example type="legal_services">
**Document text**: "Law Firm B provided legal advisory services for the project's
contractual arrangements"

**Analysis**:
- Law Firm B provides legal advice
- Legal services don't fit into implementation, carbon services, or other defined roles
- Supporting role but not directly involved in carbon credit generation
- Key phrase: "legal advisory services"

**Classification**:
- actor_name: "Law Firm B"
- role: "Other"
- activities: ["Provides legal advisory services"]
- reasoning: "Legal advisory services do not fit into other defined role categories"
</example>

<example type="environmental_certification">
**Document text**: "The project is certified under the Rainforest Alliance standard by
Certification Body C"

**Analysis**:
- Rainforest Alliance is an environmental standard, not a carbon standard
- Certification Body C performs certification, but not for carbon credits
- This is environmental certification, not carbon certification
- Key phrase: "certified under...standard"

**Classification**:
- actor_name: "Certification Body C"
- role: "Other"
- activities: ["Certifies project under Rainforest Alliance standard"]
- reasoning: "Environmental certification (non-carbon) does not qualify as Registry &
Standard role"
</example>

<example type="should_not_be_other">
**Counter-example - What should NOT be "Other"**:b>

**Document text**: "Company D manages the day-to-day operations and trains local farmers"

**Analysis**:
- Company D manages operations and provides training

```

- This clearly fits **Operation** role
- Should NOT use "Other" when a specific role applies

Classification:

- actor_name: "Company D"
- role: "Operation" (NOT "Other")
- activities: ["Manages day-to-day operations", "Trains local farmers"]
- reasoning: "Operational management and training clearly fit the Operation role definition"

Important: Do not default to "Other" - always check if the entity fits one of the eleven specific roles first

```

</example>
</role11>

</role_definitions

</role_definitions>

<critical_rules>
Critical Rules:
- An actor may have MULTIPLE roles if their activities span different categories
- Use ONLY the role names provided in the role definitions
- Base classification solely on documented activities, not assumptions
- If an actor clearly performs activities from a role category, assign that role
- The "Other" role should only be used when no other role fits
</critical_rules>
<classification_process>
Classification Process:
For each actor:
1. Review their complete activity list from Stage 3
2. Match activities to role definitions
3. For each potential role, ask: "Do their activities clearly demonstrate this role?"
4. Assign all applicable roles
5. Document your reasoning for each role assignment
</classification_process>
Role Assignment Guidance:

When activities include:
- Holding/selling carbon credits -> Primary Sales
- PDD preparation, methodology work, MRV design, carbon consulting -> Carbon Services
- On-ground implementation, training participants, field work -> Operation
- Supplying equipment, dMRV systems, or project technology -> Technology Provision
- Certifying/issuing carbon credits -> Registry & Standard
- Validating or verifying projects -> Validation & Verification
- Owning or managing project land -> Land Steward/land owner
- Providing funding or investments without explicit carbon credit purchase -> Funder
- Purchasing Credits -> Purchaser
- Conducting project-specific research studies -> Research partners
- None of the above clearly apply -> Other (use sparingly)

```

****Before classifying, think through this checklist for EACH actor:****

1. List all activities this actor performs
2. For each activity, ask: "Which role definition does this match?"
3. Check: Does this actor have activities spanning multiple roles?
4. Confirm: Am I using exact role names from <role_definitions>?

****Output for Stage 4**:** For each actor, assigned role(s) with brief justification based on activities.

</stage4>

<stage5>

Stage 5: Location Identification

****Task**:** Determine the headquarters or primary location for each actor.

****Priority order**** (be as specific as possible):

1. City, Country (ideal)
2. Region/State, Country
3. Country only
4. If truly not found: "Not found"

****Where to find location information**:**

- Contact information sections
- Organization registration details
- Address fields in tables
- About/background sections
- Images with letterheads, business cards, or contact details

<classification_process>

****Process**:**

1. Search for explicit address or location mentions
2. Check contact information tables
3. Review images for addresses on logos/letterheads
4. If multiple locations mentioned, choose headquarters (not branch offices)
5. Standardize format: "City, Country" or "Country" as appropriate

</classification_process>

****Output for Stage 5**:** Location for each actor in most granular format available.

</stage5>

<stage6>

Stage 6: Subsidiary Relationships

****Task**:** Identify if each actor is a subsidiary of a larger parent organization mentioned in the text. Only rely on information explicitly stated in the PDD.

If the actor is a subsidiary of another company, write the direct parent company. If the actor is not a subsidiary or nothing is mentioned in the PDD, write "Not found".

<critical_reminders>

- ****Completeness**:** Identify ALL actors, not just major ones

- **Evidence-based**: Every role assignment must be justified by documented activities
- **Precision**: Use only the exact role names provided
- **Active involvement**: Exclude organizations only mentioned in stakeholder consultations with no other role
- **Multiple roles**: Assign all applicable roles when an actor performs diverse activities. Actors can have multiple roles and within a project different actors can have the same role
- **Location specificity**: Provide the most granular location data available
- **Image analysis**: Don't forget to analyze images for additional actor information
- After checking all text sections and images, if information is truly not available, write "Not found" - do not make up information that isn't there

<quality_checks>

Before finalizing your output, verify:

1. Have I reviewed the entire document including all images?
2. Have I documented my reasoning for including/excluding each organization?
3. Are all role assignments backed by specific activities?
4. Have I checked for subsidiary relationships?
5. Is location information as specific as the document allows?
6. Have I avoided using generic/unorganized groups as actors?
7. Have I used the role "Other" only when no other role fits?

</quality_checks>

</stage6

</instructions>

S6.3 Value Chain Extraction

<instructions>

This codebook provides structured guidelines for extracting information about carbon projects interactions with local value chains and local benefits from carbon project descriptions. Follow these instructions carefully to ensure consistent and accurate analysis. Your role is being a research assistant that helps us extract information from carbon project descriptions.

</instructions>

<schema>

The schema for this task includes the following fields:

<objective>

Value chain information: Extract structured information about how the carbon projects interacts with local value chains.

</objective>

Extract structured information about interactions of the planned carbon project interacts with local value chains from carbon project descriptions. Add one separate entry per value chain type.

Remain neutral in your assessment regardless of the project description's tone. Use only information explicitly stated in the project description.

If no value chain exists adjacent to the project write "no value chain". If information about an aspect of a present value chain is not provided, write "Not found".

Adjacent Value Chain Definition:

A value chain is a series of activities that creates and adds value to produce a commodity or service. The name of the value chain is defined by the output commodity. We include both commercial operations and smallholder/subsistence activities like firewood collection, smallholder farming, and fishing that provide economic value to participants.

Key distinctions:

- Timber vs firewood: Timber is used for further processing; firewood/fuelwood is used directly for cooking or heating
- Biochar: Biochar is only considered a separate value chain if it is sold or further processed. If it is used for soil improvement by the same individuals who produced it on the same land, it's part of the agricultural activity, not a separate value chain (e.g. biochar made from coffee husked used in the same coffee farm shall not be considered a separate value chain but belongs to the coffee value chain).

We include value chains that:

- exist at the time of project implementation or develop during the project
- exist prior to project implementation and are substantially impacted by the project implementation
- are substantially impacted by the project (positively or negatively)
- Generate economic value or commodities beyond carbon credits
- Are run by companies, smallholders, communities, cooperatives, or other entities
- Land may be owned by smallholder farmers, companies, cooperatives, the government or communities

We do not include:

- Historical value chains that ceased to exist before project implementation (unless their cessation is directly linked to the carbon project) (e.g. abandoned farms prior to project start)
- Value chains that were given up prior to project implementation and are not directly impacted by the project
- Activities conducted purely for conservation with no economic output beyond carbon
- Value chains that coexist with but are not substantially impacted by the project
- Temporary activities - activities that are possible in some phases of the project (often during start up of the project), but not in the long term (e.g., intercropping allowed only in first years of project)

Valid value chains include, but are not limited to : coffee, cocoa, palm oil, fruits, nuts, rubber, timber, livestock, fish, bio-fertilizer, silk, and other agricultural products, whether operated by companies, smallholders, communities, or cooperatives.

Examples of Valid Value Chains

- Tree plantations for commercial timber production
- Community firewood collection from forest areas
- Community members fishing in rivers or wetlands
- Smallholder crop cultivation on their land
- Smallholders growing crops on government lands characterised through customary land use without formal ownership
- Fruit production from orchards
- Livestock grazing on project-affected land

- Informal or illegal subsistence activities like farming or firewood collections (only farming by smallholders, not illegal activities commercial companies, poachers, or miners)
- Bee keeping

Examples of Invalid Value Chains

- Tree planting solely for conservation (no commercial use)
- Former farming activities that stopped due to land degradation before project started
- Agricultural activities in the region not directly linked to project activities

</instructions>

<category 1>

value_chain:

The name of the value chain defined by its output commodity (e.g., timber, coffee, livestock, fisheries, etc.). For subsistence farmers where the output commodity is not clear, use "subsistence farming". However, if the output commodities are clear also use a separate entry for each commodity, also for subsistence farmers.

value_chain_detail: Briefly argue why this value chain is eligible based on the definition above with quotes from the project description.

</category 1>

<category 2>

value_chain_beneficiary:

Individuals, groups, cooperatives, or company that benefit from the value chain. This does not need to be the legal owner of the the land. Sometimes value chains are illegal or informal and the beneficiaries are not the legal owners of the land. That can happen when communities have access to the resources of the land around them without holding official land titles.

The beneficiary is also not determined by the carbon rights or ownership, but the usage rights or access (formalized or not) to the land or to land-based products.

If the beneficiary of the value chain changes through the project implementation, indicate the former beneficiary and the new beneficiary as "former beneficiary -> new beneficiary ". Carbon rights transfer is not relevant here, it is only about non-carbon value chains. For beneficiaries, use this option carefully, since it only applies if the value chain output stays the same but the beneficiary changes (e.g. farmers organise in cooperatives, so the beneficiary changes from smallholder farmers to cooperatives, but the output commodity stays the same). If the output commodity changes, use a new entry for the value chain.

Beneficiary categories - only use these categories:

- Farmers/Individuals: Farmers, families or individuals that benefit from the value chain
- Company: A company benefits from the value chain
- Cooperative/Communities/Collectives/NGOs: Collective benefit to local communities or local cooperative
- Mix community and individuals: Beneficiary a mix of community and individuals
- Other: If none of the above categories fit use "Other"

<examples>

<good_examples>

These are the beneficiaries of the value chain:

- Farmers that grow crops on the community land: Farmers/Individuals
- Community members that collect firewood in the forest: Farmers/Individuals
- A cooperative that harvests timber in the forest: Cooperative/Communities/

Collectives/NGOs

- A company that harvests timber in the forest: Company

- Smallholders that grow coffee on their land and are incentivised through the project to organise in cooperatives: Farmers/Individuals -> Cooperative/Communities/Collectives/NGOs

- Company takes over timber harvesting ****from another company**** and implements the carbon project: Company -> Company

</good_examples>

value_chain_beneficiary_details: Briefly argue why this beneficiary is eligible based on the definition above with quotes from the project description.

</category 2>

<category 3>

<category 3a>

land_tenure_before:

Which entity held legal decision-making authority over the land BEFORE project implementation? This is determined by legal ownership, long-term lease agreements (>10 years), or concession rights (>10 years) that existed before the project started. Land tenure is about decision-making authority, not about who currently uses or benefits from the land (although it often overlaps).

Important distinction: If farmers use land without permission (illegally or informally), the land tenure remains with whoever has legal authority (often Public), even though the farmers are the value chain beneficiaries. The beneficiary and tenure holder may be different entities.

land_tenure_before categories - only use these categories:

- Farmers/Individuals: Individual farmers or families held legal ownership or formal long-term lease/concession rights (>10 years) to the land before the project
- Company: A company held legal ownership or formal long-term lease/concession rights (>10 years) before the project
- Cooperative/Communities/Collectives/NGOs: Cooperatives, community organizations, or collectives held legal ownership or formal long-term lease/concession rights (>10 years) before the project
- Mix community and individuals: Land tenure was formally shared between community entities and individuals before the project
- Public: Government agencies/bureaus retained legal authority over land use decisions before the project
- Not found: Unable to determine who held legal authority before the project
- Other: If none of the above categories fit, specify the tenure holder

land_tenure_before_details: Briefly explain who held legal authority before the project, with quotes from the project description. Clearly distinguish between legal authority (tenure) and actual usage (beneficiary) if relevant.

</category 3a>

<category 3b>

land_tenure_after:

Which entity holds legal decision-making authority over the land AFTER project implementation? This is determined by legal ownership, long-term lease agreements (>10 years), or concession rights (>10 years) that exist after the project started.

Changes in tenure occur when:

- The project proponent leases or buys land
- Long-term concession agreements (>10 years) are signed
- Legal ownership is transferred

If the project proponent signs lease agreements (>10 years) with landowners, the proponent becomes the new tenure holder because they now have decision-making authority over the land, even if the landowners retain ownership.

Note: Carbon project lease agreements should be assumed to be >10 years unless explicitly stated otherwise in the project description, as carbon projects typically require long-term commitments.

land_tenure_after categories - only use these categories:

- Farmers/Individuals: Individual farmers or families hold legal ownership or formal long-term lease/concession rights (>10 years) to the land after the project
- Company: A company holds legal ownership or formal long-term lease/concession rights (>10 years) after the project
- Cooperative/Communities/Collectives/NGOs: Cooperatives, community organizations, or collectives hold legal ownership or formal long-term lease/concession rights (>10 years) after the project
- Mix community and individuals: Land tenure is formally shared between community entities and individuals after the project
- Public: Government agencies/bureaus retain legal authority over land use decisions after the project
- Not found: Unable to determine who holds legal authority after the project
- Other: If none of the above categories fit, specify the tenure holder

land_tenure_after_details: Briefly explain who holds legal authority after project implementation. If tenure changed from before, explain the mechanism (lease agreement, purchase, concession, etc.) with quotes from the project description. Clearly distinguish between legal authority (tenure) and actual usage (beneficiary) if relevant.

CRITICAL: If the interaction is "Negative" or "Ambiguous" and involves restrictions, loss of access, or displacement, verify whether a tenure change occurred through leases (>10 years), purchases, or concessions. If yes, land_tenure_after should reflect the new tenure holder (often the project proponent/company).

</category 3b>

<examples>

<good_examples>

Example 1: Individual farm incorporation

- land_tenure_before: Farmers/Individuals
- land_tenure_after: Farmers/Individuals
- Explanation: 100 farms totaling 398 ha incorporate the project on their fields. Farmers retain ownership and decision-making authority.

Example 2: Customary grazing land

- land_tenure_before: Public
- land_tenure_after: Public
- Explanation: Farmers grow grains on public land governed by customary rights. Government retains legal authority both before and after.

Example 3: Community livestock grazing

- land_tenure_before: Public
- land_tenure_after: Public
- Explanation: Livestock grazing land used by community members without formal land ownership. Government agency decides on land use before and after project.

Example 4: Unclear initial tenure

- land_tenure_before: Not found
- land_tenure_after: Company
- Explanation: Farmers use land but it is unclear who held legal authority before. Company now holds lease agreement.

Example 5: Government land leased to company

- land_tenure_before: Public
- land_tenure_after: Company
- Explanation: Farmers used lands without clear ownership for livestock grazing. Through project initiation, a government agency leases land to company for >10 years.

Example 6: Company forestry concession

- land_tenure_before: Company
- land_tenure_after: Company
- Explanation: Company-owned timber plantation with ongoing forestry concession starts integrating carbon project. Company retains decision-making authority.

Example 7: Public land purchased by company

- land_tenure_before: Public
- land_tenure_after: Company
- Explanation: Firewood collection occurred on formerly public land that is purchased by company to implement a carbon project.

Example 8: Public fishing waters

- land_tenure_before: Public
- land_tenure_after: Public
- Explanation: Fishing activities on public waters. Government retains authority over water resources and coastal area.

Example 9: Illegal farming on government land

- land_tenure_before: Public
- land_tenure_after: Public

- Explanation: Farmers illegally farm on abandoned government land. Government retains legal authority despite illegal use.

Example 10: Family land leased to company

- land_tenure_before: Farmers/Individuals

- land_tenure_after: Company

- Explanation: Landowning families hold legal ownership of land before the project.

Company develops lease agreements with families for portions of their degraded land. Because these are long-term leases for a carbon project, the lease transfers decision-making authority to the company for the leased portions, changing tenure from Farmers/Individuals to Company.

Example 11: Cooperative forest management

- land_tenure_before: Cooperative/Communities/Collectives/NGOs

- land_tenure_after: Cooperative/Communities/Collectives/NGOs

- Explanation: A cooperative holds long-term forest management concession (>10 years) and continues to hold it after project implementation.

Example 12: Mixed tenure transition

- land_tenure_before: Mix community and individuals

- land_tenure_after: Company

- Explanation: Land formally shared between community entities and individual families is leased to a company for carbon project implementation.

</good_examples>

<key_principles>

- Legal authority (tenure) != Current usage (beneficiary)

- Lease agreements >10 years transfer tenure to the leaseholder

- Carbon project leases are assumed to be >10 years unless stated otherwise

- If project restricts access through leases/purchases, tenure likely changed

- Tenure can stay the same even if beneficiaries change

- Always evaluate both before AND after states separately

</key_principles>

</examples>

</category 3>

<category 4>

interaction:

The relationship between the project and the value chain. Be objective, don't be influenced by a potentially positive project description tone. Use the following categories to classify the interaction:

- Positive: A positive interaction occurs when the value chain beneficiary benefits from the carbon project and output quantity or resilience is positively impacted by the carbon project. This positive impact carries on at least throughout the project duration. Allowing the value chain activities in a project area is not sufficient to classify the interaction as positive, there must be a clear benefit to the value chain beneficiary.

- Negative: The value chain is harmed by the project. This can happen through restrictions, displacement, or reduced access. This can include restrictions on land previously used for the value chain (i.e. through change in land ownership), reduced access to resources, or reduced output quantity. Benefits related to the carbon project (e.g. jobs, income, infrastructure) do not count as positive interactions with the value chain.

- Ambiguous: The value chain experiences both positive and negative consequences from the projects and it is not clear which one outweighs the other. This can include cases where the project restricts access to resources but also improves the value chain's resilience or output quantity.

- Enabler: The project creates entirely new value chains that didn't exist before in the region.

- Neutral: The project has no significant impact on the value chain, or offers alternatives that people can freely choose without restriction

<examples>

<examples_positive>

Examples of Positive Interactions:

- Biochar production and application by smallholders that improves crop yields: positive

- Technology solution enhances market access for commodity: positive

- Tree planting rehabilitates previously unusable grazing land without displacing livestock

: positive

- Improved forest management enables sustainable timber harvesting and, therefore, improves resilience to climate change: positive

- Rotational grazing introduction improves livestock productivity without displacing livestock: positive

</examples_positive>

<examples_negative>

These are examples of negative interactions:

- Project restricts access to previously used farmland (even if formerly illegal or unofficial): negative

- Project ends commercial timber harvesting to protect/conserves forest: negative

- Project restricts access to fishing waters: negative

- Project restricts access to farmland used by smallholders but offers alternative income sources like jobs or income generation: negative

- Project restricts access to previously used farmland, but offers farmers to plant crops between trees until trees are mature: negative

- Project area was formerly used for subsistence farming but will not be reforested for a carbon project and farmers are not allowed to use the land anymore. However, farmers are allowed to do intercropping for the first three years: negative

</examples_negative>

<examples_ambiguous>

These are examples of ambiguous interactions:

- Project restricts local fishing but improves regional fish habitat through mangrove planting: ambiguous

- Project takes land for tree planting but increases surrounding areas' agriculture disaster resilience: ambiguous

</examples_ambiguous>

<examples_enabler>

These are examples of enablers for new value chains:

- Project plants trees for future timber production where none existed: enabler

- Agroforestry project introduces new fruit tree species: enabler
- Construction of new power plant to support project activities: enabler

</examples_enabler>

<examples_neutral>

These are examples of neutral interactions:

- Project offers optional incentives for perennial crop planting without restricting annual crops planting: neutral
- Project uses abundant resources also used by other value chains: neutral
- Project coexists with other land uses without restricting access: neutral

</examples_neutral>

</examples>

interaction_details: Briefly argue why you chose this interaction based on the definition above with quotes from the project description.

</category 4>

<process>

Proceed in your evaluation in the following way:

1. Identify all potential value chains mentioned in the project description. For each of the value chains proceed the following:

2. Is value chain ongoing at the time of project implementation? If yes, proceed, if value chain ceased to exist before project implementation discard value chain.

3. Who benefits from the value chain? -> fill in value_chain_beneficiary

4. LAND TENURE BEFORE PROJECT IMPLEMENTATION - Who holds legal decision-making authority over the land?

- Look for: legal ownership, existing long-term lease holders (>10 years), or concession holders (>10 years)

- If both owner and lease/concession holder exist, choose the lease/concession holder (they hold the right to decide on land use)

- If communities/farmers use land informally without formal ownership or leases, identify who has legal authority (often Public/government)

- Document this in land_tenure_before

5. LAND TENURE AFTER PROJECT IMPLEMENTATION - Who holds legal decision-making authority over the land?

- Check if the project involves: land purchase, new lease agreements (>10 years), or new concession agreements (>10 years)

- If the project proponent signs lease/concession agreements with landowners, the proponent becomes the new tenure holder

- Key indicators: If the interaction details mention "restrictions," "loss of access," "displacement," or "lease agreements," this strongly suggests a tenure change has occurred

- If both owner and lease/concession holder exist after implementation, choose the lease/concession holder

- Document this in land_tenure_after

6. CROSS-CHECK TENURE WITH INTERACTION: If you identified a negative or ambiguous interaction involving restrictions, displacement, or loss of access, verify that `land_tenure_after` reflects any new tenure holder from leases or purchases. Restrictions often result from tenure transfers. Also the interaction "enabler" it can be through a new land tenure holder.

7. Does the carbon project influence the value chain? If yes proceed below, if not write to interaction "neutral"

8. Fill direction of interaction based on description above.

</process>

<output_format>

For each field pair (details + classification):

1. FIRST: Analyze the evidence and write the "_details" field with quotes and reasoning
2. THEN: Based on that analysis, select the appropriate classification category
3. Never classify first and then rationalize - always reason first, then classify

This order is critical for accurate analysis.

</output_format>

</schema>

S7 LLM Checklist

Here, we present the key information proposed by [Feuerriegel et al. \(2026\)](#) in their LLM-Checklist.

How to complete the checklist:

Scope of LLM use	Answer
Item A.1: LLMs were used in this project for:	The LLM was used for data processing and data analysis. As a data preparation step we classified all images in the project description as relevant and irrelevant to reduce information in the next classification step. We, then extract involved actors and impacted value chains from unstructured carbon project descriptions and relevant images. Finally, we classify actors roles, and value chains' beneficiary, land tenure holder (before & after project), and interaction with carbon project.
Item A.2: Degree of automation (human-in-the-loop vs. fully automated):	The extraction process is fully automated. The results are validated against a human-compiled dataset (see Section S3).

Model/system details	Answer
Item B.1: Model name, including provider, model size, exact version/ID, date of access, and source link (if possible):	In this paper we used the model "claude-sonnet-4-5-20250929" by Anthropic accessed in November 2025 for textual extraction of data. Further, we use "gpt-4.1-mini-2025-04-14" by OpenAI accessed in May 2025 to classify relevant images from carbon project descriptions. Relevant images were passed to the Anthropic model.

Item B.2: Model access (e.g., API, web interface, local) and context mode (e.g., chat mode or separate calls):	<ul style="list-style-type: none"> • GPT-Mini: we used OpenAI's API without state. Each image is a separate request. • Claude Sonnet: We used the Batch API with one request per project descriptions. Therefore there is no common state between projects.
Item B.3: Relevant LLM configurations reported (as applicable), such as temperature, max tokens, seed, and number of runs:	<ul style="list-style-type: none"> • GPT-Mini: temperature = 0; max_tokens = 300 • Claude Sonnet: temperature = 0; max_tokens = 12,000, top_k=0
Item B.4: Customization:	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Base model <input type="checkbox"/> Fine-tuning <input type="checkbox"/> RAG (retrieval-augmented) <input type="checkbox"/> Automated prompt optimization <input type="checkbox"/> Tool/function calling <input type="checkbox"/> Web search <input type="checkbox"/> Agentic workflows <input type="checkbox"/> Other adaptations (e.g., safety mechanisms)
Item B.5: Did the LLM session(s) include persistent memory across interactions?	<ul style="list-style-type: none"> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A

Prompts	Answer
Item C.1: Exact prompt(s) reported:	Prompts for image filtering (Section S6.1), actor extraction (Section S6.2), and value chain extraction (Section S6.3) are reported in this Supplementary Information.
Item C.2: System-wide instructions (if any):	<ul style="list-style-type: none"> • Image Filtering: None • Actor and value chain processing: "You are a research assistant that extracts structured data from a carbon project description document. It is very important that you only rely on information given in the project description text or the images provided to you. Use the provided text delimited by tripple quotes to answer questions. If the answer cannot be found in the article, write 'Not found'. Also use provided images to extract information if images contain relevant information."

Data inputs & privacy	Answer
Item D.1: Handling of personal or sensitive data (if any) (e.g., consent for data processing):	Not applicable - All data used in this study is publicly available.

Validation & interpretation	Answer
Item E.1: Human validation of LLM outputs:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A Description: The human validation process is described in Detail in section S3. The validation was purely used for assessing output quality. Prompt refinement was done based on projects that where not in project test set.
Item E.2: Describe any relevant post-processing (e.g., filtering in case of format mismatches, unit conversions, etc.):	In the post-processing the names of extracted actors and their locations where harmonized. This is described in the main text in Sections 4.7 and 4.8.

Reproducibility	Answer
Item F.1: Code/notebooks/scripts for LLM calls shared:	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A Available upon publication. Link/DOI:

Competing interests	Answer
Item G.1: Funding, support, or other relevant relationships (including in-kind access to compute or models, or professional affiliations):	<input type="checkbox"/> Yes. Description: <input checked="" type="checkbox"/> No

References

- Feuerriegel S, Barrie C, Crockett MJ, et al (2026) A consensus-based reporting checklist for large language models in behavioral and social science, URL <http://www.llm-checklist.com/>
- Verra (2024) Verra releases updated fee schedule. URL <https://verra.org/verra-releases-updated-fee-schedule/>