

Table S1. List of variables used to characterize the four studied communities. The *First-* and *Second-* tier variables are standard in the literature, but the indicator variables were developed specifically for this study.

<i>First-tier variable</i>	<i>Second-tier diagnostic variables</i>	<i>Indicator variables</i>
Social, economic, and political settings (S) :	S1 – Economic development	S1a - Cocoa production activity supported by provincial government
	S2 – Demographic trends	S2a - Population growth rate in Amazonian indigenous communities
	S3 – Political stability	S3a - Provincial government actions in accord with national policies.
	S4 – Other governance systems	S4a - Presence of community-based organizations
	S5 – Markets	S5a - Access to national and international markets
	S6 – Media organizations	S6a - Support or interest in cocoa production activities and socio-environmental projects
	S7 – Technology	S7a - Climate alerts systems S7b - Level of infrastructure development (cocoa transformation facilities)
Resource systems (RS): Agricultural land use in Amazonian rainforest - Pumayacu community	RS1 – Sector : Amazonian rainforests	RS1a - Land availability for agricultural activities
	RS2 – Clarity of system boundaries	RS2a - Anthropogenic (political) boundaries RS2b - Natural boundaries
	RS3 – Size of resource system	RS3a - Pressure on land use
	RS4 – Human-constructed facilities	RS4a - Roads to take their products out to markets RS4b - Infrastructure to access agricultural lands
	RS5 – Productivity of system	RS5a - Suitable land for cocoa production
	RS6 – Equilibrium properties	RS6a - Interaction between subsystems: fisheries, water provisions, cattle, fish farming, forest exploitations, ...
	RS7 – Predictability of system dynamics	RS7a - Cocoa production in the same periods of the year
	RS8 – Storage characteristics	RS8a - Drying and fermenting cocoa centers (post-harvest process) in the community
	RS9 – Location	RS9a - Buffer or expansion zones (communal reserve lands)
Governance systems (GS): Pumayacu Kichwa community	GS1 – Government organizations	GS1a - Presence or proximity to government (central and regional) representatives GS1b - Presence or proximity to community-based organizations
	GS2 – Nongovernment organizations	GS2a - Presence of NGOs and international cooperation agencies
	GS3 – Network structure	GS3a - Presence or proximity to commercial actors who purchase cocoa production
	GS4 – Property-rights systems	GS4a - Communal property right system
	GS5 – Operational-choice rules	GS5a - Existence of rules and formal guidelines of cocoa production
	GS6 – Collective-choice rules	GS6a - Control committees in cocoa production
	GS7 – Constitutional-choice rules	GS7a - Membership (voice and vote) from cocoa small producers association
	GS8 – Monitoring and sanctioning rules	GS8a - Control and monitoring agreements for cocoa certification process

		GS8b - Internal sanctioning agreements over cocoa certification process
Resource units (RU): Nacional Cacao production	RU1 – Resource unit mobility	RU1a - Control over cocoa seeds exchange within other actors
	RU2 – Growth or replacement rate	RU2a - Growth or replacement rate of <i>Nacional</i> cocoa tree
	RU3 – Interaction among resource units	RU3a - Cocoa production use of the available arable land
	RU4 – Economic value	RU4a - Difference in economic value of <i>Nacional</i> (organic) cocoa compared to ordinary cocoa
	RU5 – Number of units	RU5a - <i>Nacional</i> cocoa trees per hectare: > or < 1000 trees/hectare
	RU6 – Distinctive characteristics	RU6a - Presence of <i>Nacional</i> cacao enhanced clones
		RU6b - Presence of <i>Criollo</i> and other native cocoa species like white cocoa (<i>Theobroma bicolor</i>) and wild cocoa trees (<i>Herrania spp.</i>) in plantations
	RU7 – Spatial and temporal distribution	RU6c - Presence of cocoa clone CCN51 in plantations
RU8 - Subtractability	RU7a - Homogeneity of <i>Nacional</i> cocoa production in the community's agricultural lands	
		RU8a - Rules of use to extract cocoa seeds
Actors (A): Indigenous Communities	A1 – Number of relevant actors	A1a - Well-organized directive
	A2 – Socioeconomic attributes	A1b - Delegation of power
		A2a - Socioeconomic attributes
	A3 – History or past experiences	A3a - Traditional uses and culture development of cacao in the community
		A3b - Occupation of ancestral territories
	A4 – Location	A4a - Access and proximity to markets
	A5 – Leadership/entrepreneurship	A5a - Collective support for Leadership/entrepreneurship
	A6 – Norms (trust-reciprocity)/social capital	A6a - Respect to ancient communities values
		A7a – Knowledge of ‘El niño’ and ‘La niña’ effects over their production
A7 – Knowledge of SES/mental models	A7b - Clarity and understanding of the certification processes	
A8 – Importance of resource (dependence)	A8a - Cocoa production considered as main income activity	
	A9a - Fixed telephone	
A9 – Technologies available	A9b - Mobile telephone connection	
	A9c - Internet access	
Action situations: Interactions (I) → Outcomes (O)	I1 – Harvesting	I1a - <i>Nacional</i> organic cacao productivity
	I2 – Information sharing	I2b - Fluidity of information over cocoa market situation
		I2a - Fluidity in cocoa production process between actors and stakeholders
	I3 – Deliberation processes	I3a - Collective deliberation process (Assemblies) in cocoa production issues
	I4 – Conflicts	I4a - Conflicts between certified and non-certified producers
	I5 – Investment activities	I5a - Investment activities to improve cocoa production / post-harvest process/ international certification
I6 – Lobbying activities	I6a - Influence of users over cocoa final price	

I7 – Self-organizing activities	I7a - Internal rules for collective management in the cocoa production process; Active search for markets and /or certification processes
I8 – Networking activities	I8a - Cooperation and partnerships with external actors over cocoa production (NGOs - government)
I9 – Monitoring activities	I9a - Collective agreements to control cocoa production quality
I10 – Evaluative activities	I10a - Assessment of compliance with certifications guidelines
O1 – Social performance measures (e.g., efficiency, equity, accountability, sustainability)	O1a - Vulnerability to external economic impacts
O2 – Ecological performance measures (e.g., overharvested, resilience, biodiversity, sustainability)	O2a - Vulnerability to environmental pressures
O3 – Externalities to other SESs	O3a - Emergence of other activities looking for more incomes that can create stress over other SES.

Related ecosystems (ECO)	ECO1 – Climate patterns	ECO1a
	ECO2 – Pollution patterns	ECO2a
	ECO3 – Flows into and out of communities	ECO3a - Cocoa production inputs and outputs