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Sustainable Livelihood-Based Value Chain Articulation Model for Rural Poverty Reduction: A Value Links Application to Guinea Pig Production in the Peruvian Andes

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Abstract*– Limited productive and commercial coordination within rural high-Andean agricultural systems constitutes a structural constraint to sustainable income generation and the reduction of socioeconomic vulnerability. In these contexts, fragmented production, small operational scale, and weak integration into formal markets negatively affect technical efficiency and profitability. This study proposes an integrated strengthening model for the guinea pig value chain in the district of Huachis (Áncash, Peru), through the combined application of the Sustainable Livelihoods Approach and the Value Links methodology. The Sustainable Livelihoods framework enabled a quantitative assessment of human, physical, financial, natural, and social capital, identifying structural gaps directly linked to low productivity and limited household resilience. Baseline analysis revealed productivity levels approximately 30% below regional technical benchmarks and limited access to formal credit (less than 20% of producers). Based on this diagnosis, the Value Links methodology facilitated actor mapping, value flow analysis, and identification of coordination failures across chain segments. The proposed upgrading strategies project measurable outcomes, including a 25–35% increase in productivity per production unit, a 15–20% reduction in transaction costs through associative coordination, a 20% increase in net household income, and a 30% growth in formal or differentiated market participation. Additional targets include a 40% increase in producer formalization and strengthened collective governance structures. The proposed model enhances territorial economic sustainability and provides a replicable quantitative framework for value chain transformation in vulnerable rural environments.

Keywords*-- Guinea pig value chain, sustainable livelihoods framework, value chain articulation, rural economic development, small-scale livestock systems.

I. Introduction

The persistence of structural gaps in rural agricultural systems constitutes one of the main barriers to sustainable development in Latin America. At the regional level, approximately 45% of the rural population lives in poverty and faces significant constraints in accessing markets, financial services, and productive technologies [1]. In Peru, 30.1% of the rural population is affected by monetary poverty, a rate that significantly exceeds the urban average [2]. Moreover, more than 70% of agricultural production units correspond to smallholders operating on less than five hectares, characterized by low capitalization levels and limited integration into formal value chains [3].

Within this context, guinea pig production (Cavia porcellus) plays a strategic role in the high-Andean rural economy. Peru is the world's leading producer of guinea pigs, with an estimated annual output exceeding 16 million units and growing domestic and international demand driven by its nutritional and cultural value [4], [5]. However, the guinea pig value chain exhibits high levels of fragmentation: over 80% of producers operate under small-scale family-based systems, with average productivity levels approximately 25–35% lower than those of regional technified systems [3]. Such productivity constraints constrain value capture at the producer level, resulting in narrower operating margins, limited sanitary formalization, and reduced bargaining leverage within vertically fragmented and intermediary-driven value chains.

From a global value chain perspective, insufficient vertical and horizontal coordination limits opportunities for productive upgrading and restricts value capture among small producers [6], [7]. Furthermore, recent rural development studies emphasize that the economic vulnerability of agricultural households is closely linked to the availability and quality of productive assets human, physical, financial, natural, and social capital, and to the institutional coordination capacity within the territory [8], [9].

In high-Andean areas such as the district of Huachis (Áncash, Peru), these structural constraints are reflected in limited access to continuous technical assistance (less than 30% of producers), low access to formal credit (below 20%), and deficiencies in productive and sanitary infrastructure. These conditions undermine technical efficiency, resilience to external shocks, and the potential for integration into differentiated markets.

In response to this scenario, comprehensive approaches are required that combine territorial analysis with strategic value chain redesign tools. The Sustainable Livelihoods Approach

enables a multidimensional assessment of vulnerability conditions and rural household economic strategies, incorporating asset analysis, institutional context, and power structures [8], [10]. Complementarily, the Value Links methodology provides a systematic framework for actor mapping, chain segmentation analysis, bottleneck identification, and the design of upgrading and collaborative governance strategies [11].

This research proposes an integrated model for strengthening the guinea pig value chain in Huachis by articulating both methodological approaches within a quantitative framework for productivity gap assessment and projected performance improvements. It is hypothesized that a systemic intervention based on institutional coordination, technological upgrading, and organizational strengthening can generate projected productivity increases of 25–35% per production unit, improvements exceeding 20% in net household income, and a significant reduction in transaction costs through associative mechanisms.

The primary contribution of this study lies in integrating a quantitative livelihoods diagnosis with a structured value chain redesign model, providing a replicable framework for transforming small-scale agricultural systems in rural contexts characterized by high structural vulnerability.

II. State of the Art

Rural development in emerging economies has historically been approached through productivist paradigms centered on increasing agricultural yields. However, the accumulated empirical evidence of recent decades demonstrates that growth in output does not necessarily translate into sustainable poverty reduction nor into territorial economic resilience. In Latin America, the persistence of structural gaps in rural areas is explained by the combined effects of low capital accumulation, imperfect markets, limited infrastructure, and institutional fragility [1]. These constraints configure an environment in which small-scale producers operate under conditions of high vulnerability and reduced capacity for value capture.

In Peru, the agrarian structure is predominantly composed of smallholder family farming systems, with more than 70% of productive units operating on less than five hectares and exhibiting limited capitalization levels [3]. This structural fragmentation directly affects technical efficiency, technological adoption, and integration into formal markets. From a development economics perspective, this dynamic has been described as a "low-productivity trap," whereby insufficient asset endowment and restricted market access prevent processes of accumulation and productive upgrading.

The Sustainable Livelihoods Framework (SLF) has emerged as one of the most influential approaches for addressing these issues from a multidimensional perspective. Scoones [8] posited that livelihood sustainability depends on the dynamic interaction among human, physical, financial, natural, and social capital within a given institutional and vulnerability context. Ellis [9] further emphasized income diversification and adaptive strategies as central mechanisms of rural resilience. Bebbington [12], in turn, incorporated the dimension of power and differential access to assets as key explanatory factors for territorial inequality.

Despite its analytical strengths, the SLF has been questioned regarding its operational capacity to guide specific productive interventions, particularly in terms of economic efficiency and competitive performance. Recent literature on territorial resilience suggests that assets should be analyzed not only in terms of availability but also in relation to their articulation within market structures and productive governance systems.

At this juncture, Global Value Chain (GVC) theory provides a complementary analytical framework. Humphrey and Schmitz [6] introduced the concept of upgrading as the process through which economic actors improve their position within the chain through process, product, or functional innovation. Gereffi, Humphrey, and Sturgeon [7] later developed a governance typology explaining how power asymmetries shape rent distribution and learning opportunities. Empirical evidence indicates that smallholders often remain confined to primary segments of the chain due to high transaction costs, dependency on intermediaries, and weak horizontal coordination.

Transaction cost economics reinforces this interpretation by arguing that uncertainty, asset specificity, and information asymmetries generate inefficient market structures that diminish the bargaining power of dispersed producers [13]. In highland rural contexts characterized by informal relations and fragmented markets, these costs materialize in compressed margins and limited formalization.

From an applied development perspective, the Value Links methodology developed by German cooperation provides a structured framework for the analysis and promotion of productive chains in developing contexts [11]. Its approach integrates actor mapping, functional chain analysis, bottleneck identification, and upgrading strategy design. FAO [14] has emphasized that structured value chain interventions can enhance productivity and market access when combined with organizational and institutional strengthening.

Nevertheless, a persistent conceptual gap remains in the literature. While the livelihoods approach effectively explains the structural vulnerability of rural households, and value chain analysis identifies competitiveness opportunities, both frameworks are frequently applied independently. There is

limited empirical evidence integrating territorial asset analysis with strategic value chain redesign within a quantitative model capable of projecting measurable impacts on productivity, income, and transaction cost reduction.

In small-scale livestock systems such as guinea pig production in the Andean region, this analytical gap is particularly evident. Although Peru is the world's leading producer of guinea pigs, the chain remains highly atomized and dominated by informal intermediation [3], [15], [16]. Technical studies have largely focused on zootechnical and sanitary aspects, while governance structures, institutional coordination, and value capture dynamics have received comparatively limited attention from a systemic perspective.

The present research positions itself at this theoretical intersection by proposing an integrated model that articulates structural livelihood diagnosis with strategic value chain redesign, incorporating quantifiable indicators of productivity, income, and transaction costs. This methodological convergence seeks to overcome prevailing analytical fragmentation and to contribute to the development of a replicable framework for transforming small-scale agricultural systems operating in contexts of structural rural vulnerability.

III. Methodology

The methodological strategy adopted in this study is grounded in the need to articulate a structural diagnosis of territorial vulnerability with a competitive value chain assessment under a systemic and quantifiable framework. Given that small-scale livestock systems face constraints both at the level of productive assets and market governance structures, a sequential methodological design was developed integrating the Sustainable Livelihoods Approach with value chain analysis tools. This integrated framework enables the identification of structural gaps at the household level and, critically, the translation of these constraints into concrete strategies for productive, organizational, and institutional upgrading. The methodology is organized into two complementary phases that converge into an integrated intervention model with a quantitative projection of impacts on productivity, income generation, and transaction cost reduction.

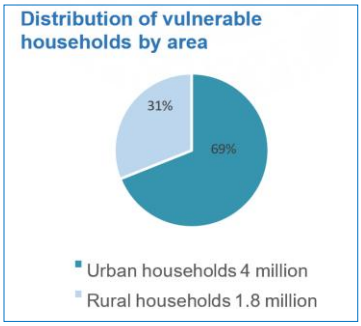

Fig. 1 - Distribution of vulnerable urban and rural households in Peru [17]

A. Research Design and Analytical Framework

The study adopted an applied research design with a predominantly quantitative approach complemented by qualitative validation. The research was conducted in the district of Huachis, Huari province (Áncash, Peru), a high-Andean territory characterized by small-scale family-based guinea pig (Cavia porcellus) production systems, limited technological adoption, and weak formal market integration.

Fig. 2 - Geographic location of Huachis [18]

The unit of analysis consisted of family production units engaged in traditional and semi-technified guinea pig farming. Primary data were collected through structured surveys, technical production records, semi-structured interviews, and participatory workshops with producers.

The methodological framework integrated two complementary analytical approaches:

- **The Sustainable Livelihoods Approach (SLA)**, applied to conduct a multidimensional diagnosis of structural vulnerability.
- **The Value Links methodology**, employed for functional value chain analysis and the design of productive and institutional upgrading strategies.

This integration enabled the linkage of micro-level productive asset analysis with the systemic redesign of the value chain.

B. Unit of Analysis and Sampling Strategy

The unit of analysis comprises family-based production units engaged in guinea pig (Cavia porcellus) farming in the district of Huachis (Áncash, Peru). This research follows an applied, non-experimental design with explanatory propositional scope. It is applied insofar as it seeks to formulate a concrete productivity-enhancement model; non-experimental because no independent variables are manipulated; and explanatory because it aims to identify structural factors

underlying low productivity and weak market integration among producers.

The study was conducted in the district of Huachis, Huari Province, Áncash region, Peru Andean territory characterized by family-based guinea pig production systems operating under traditional and semitechnified schemes. The unit of analysis consisted of active household-level production units during the study period. Primary data were collected through structured surveys, technical production records, semi-structured interviews, and participatory workshops. This mixed approach enabled the integration of quantitative measurement with qualitative validation.

The sample was defined through a non-probabilistic convenience sampling approach guided by technical–productive criteria, including:

- Producers with active operations during the previous 12 months.
- Units maintaining a minimum and consistent production level.
- Availability of reliable productive and commercial records.

The resulting sample size allowed for the capture of structural heterogeneity in production scale, asset endowment, and degree of market integration.

C. Structural Diagnosis through the Sustainable Livelihoods Framework

The first methodological component consisted of applying the Sustainable Livelihoods Framework (SLF), which allows a multidimensional assessment of household capacity to generate sustainable income based on asset endowment. The framework recognizes five key capitals: human, physical, financial, natural, and social.

Human capital was evaluated through variables such as education level, production experience, and access to technical assistance. Physical capital included infrastructure quality, sanitary equipment, and installed production capacity. Financial capital incorporated access to credit, cost structure, and estimated gross margins. Natural capital considered forage availability and exposure to climatic variability. Social capital was measured through associativity levels, organizational participation, and horizontal coordination mechanisms.

To synthesize this information, a Composite Livelihood Index (CLI) was constructed as a weighted aggregation of the five normalized capital dimensions. Normalization allowed comparability across heterogeneous indicators and reduced scale bias. The index enabled classification of producers into vulnerability tiers and revealed that the most significant structural gaps were concentrated in physical, financial, and social capital factors directly affecting value chain positioning.

The livelihood analysis was structured around five forms of capital:

- Human Capital (HC)
- Physical Capital (PC)
- Financial Capital (FC)
- Natural Capital (NC)
- Social Capital (SC)
- Capital social (CS)

For each capital dimension, observable indicators were defined and normalized on a continuous scale within the interval [0,1], enabling comparability and aggregation across dimensions.

C.1. Construction of the Composite Livelihood Index (CLI): A synthetic index was developed through a weighted aggregation procedure, integrating the five capital dimensions into a single composite measure:

$$CLI_i = \sum_{j=1}^{5} w_i C_{ij}$$

Where:

- C_{ij} = normalized value of capital j for producer i.
- w_i = weight assigned to each capital dimension

The index enables the identification of comparative structural gaps and the classification of productive vulnerability levels across households.

C.2. Measurement of the Productive Gap: Productivity was measured as:

$$P_i = \frac{Q_i}{U_i}$$

Where:

- Q_i = Annual production (in units or kilograms).
- U_i = The number of breeding units.

The relative productive gap was calculated by comparing the observed productivity level with a benchmark value,

$$GAP_i = \frac{Prod_{ref} - Prod_i}{Prod_{ref}} x100$$

where $Prod_{ref}$ represents the average productivity of regionally technified production systems.

D. Structural Value Chain Analysis through the Value Links Methodology

The second methodological component involved analyzing the guinea pig value chain using the Value Links framework. Rather than serving merely as a descriptive mapping tool, the methodology was applied as a structured analytical model to

examine economic relations, governance patterns, and value distribution across chain segments.

The chain was delineated across input supply, primary production, local aggregation, regional commercialization, and final consumption. The mapping process identified actors, physical and monetary flows, and coordination mechanisms. Price analysis by segment revealed that producers capture a relatively small proportion of final market value, while intermediaries and traders retain higher relative margins.

Fig. 3 - Ceramics from the Chimú culture [19]

Governance assessment considered transaction characteristics, contractual formalization, and bargaining power asymmetries. Findings indicate a market-based governance structure with captive features, characterized by informal agreements, information asymmetry, and limited horizontal coordination. This configuration increases transaction costs and constrains functional upgrading.

The analysis demonstrated that technical constraints, such as traditional infrastructure or lack of product standardization, are compounded by weak collective organization. Fragmented production elevates search and negotiation costs, directly reducing net income.

E. Methodological Integration and Impact Modeling

The core methodological contribution of this study lies in integrating structural asset diagnosis with value chain restructuring. Producers' chain positioning was found to be functionally dependent on their asset endowment, particularly physical and social capital. This relationship links structural vulnerability to value capture capacity.

Based on this integration, a quantitative impact projection model was developed. Productivity was estimated as total output per reproductive unit, while net income was calculated as the difference between sales revenue and total production costs. Scenario simulations incorporating partial technological upgrading and associative commercialization projected productivity increases between 25% and 35%, net income growth exceeding 20%, and transaction cost reductions between 15% and 25%.

By integrating territorial asset analysis with value chain upgrading and economic simulation, the methodology advances beyond descriptive diagnostics and offers a replicable strategic framework capable of generating measurable economic outcomes. The methodological integration enabled linking the producer's position within the value chain to their asset endowment:

$$insertion_{chain} = f(CH, CF, CF_i, CS)$$

The findings indicate that producers with stronger social and physical capital demonstrate greater bargaining power and reduced dependence on intermediaries.

Fig. 4 - Guinea pig sheds in Huachis

IV. Results

The findings indicate that the productive constraints observed in the guinea pig production system in Huachis cannot be attributed solely to isolated technical deficiencies, but rather to a structural configuration of insufficiently articulated assets within the value chain. The Composite Livelihood Index reveals that physical, financial, and social capital levels remain below the threshold required for productive sustainability, generating a negative multiplier effect on productivity and value capture capacity.

From an economic standpoint, the estimated productivity gap (25–30%) cannot be explained exclusively by differences in zootechnical management. Instead, it results from the interaction between limited infrastructure, low technological density, and high transaction costs associated with individualized marketing. This finding aligns with value chain theory, which posits that producers' relative positioning within a system depends not only on internal efficiency but also on governance structures and vertical coordination mechanisms.

Moreover, the asymmetric distribution of margins evidences a concentration of value capture in intermediate segments, a pattern consistent with fragmented production structures and weak horizontal associativity. In the absence of

collective coordination mechanisms, producers face information asymmetries and reduced bargaining power, limiting their share of the total value generated along the chain.

Scenario simulations further demonstrate that a systemic intervention, combining technological upgrading, organizational strengthening, and institutional articulation, could generate productivity gains exceeding 25% and increases in net household income above 20%, while reducing transaction costs by nearly half. These results underscore that structural transformation is not driven exclusively by investment in physical assets, but by the strategic integration of social capital and collaborative governance. Methodologically, integrating the Sustainable Livelihoods diagnostic framework with strategic value chain redesign addresses the analytical fragmentation commonly found in prior studies. While the livelihoods approach explains structural vulnerability, the value chain perspective identifies concrete upgrading mechanisms and value capture pathways. Their convergence provides a replicable framework for rural interventions in contexts characterized by structural constraints.

In summary, the results validate the hypothesis that institutional and technological articulation enhances economic performance and demonstrate that productive upgrading is a direct function of the interaction between territorial assets and market structures. This empirical evidence contributes an operational model for the sustainable transformation of small-scale agricultural systems.

A. Baseline Livelihood Capital Assessment

The application of the Sustainable Livelihoods Framework (SLF) enabled the construction of a composite Livelihood Capital Index (LCI) integrating five dimensions: human, physical, financial, natural, and social capital. Each dimension was normalized using a min–max scaling procedure and weighted according to expert validation and principal component contribution.

The baseline composite index for the study area revealed a structural deficit in productive assets, with an average LCI value of 0.41 on a 0–1 scale, indicating moderate-to-high vulnerability. Table 1 presents the baseline values by capital dimension.

Table I - Baseline Livelihood Capital Index by Dimension

Capital Dimension	Normalized Index	Structural Gap Identified
Human Capital	0.48	Limited technical training and low adoption of improved breeding practices
Physical Capital	0.37	Deficient infrastructure (housing systems, sanitation, feeding facilities)
Financial Capital	0.33	Restricted access to formal credit (<20%)
Natural Capital	0.55	Adequate forage availability but low productivity management
Social Capital	0.32	Weak associative organization and limited collective bargaining

The lowest-performing components were financial and social capital, confirming that structural vulnerability is not solely technological but institutional and organizational.

B. Value Chain Structural Mapping

The Value Links methodology enabled the systematic mapping of the guinea pig value chain, identifying five primary functional stages:

1. Input supply
2. Production
3. Collection and aggregation
4. Slaughtering and processing
5. Commercialization

The analysis revealed a highly fragmented production base, with more than 80% of producers operating at small family scale. Intermediation dominated commercialization, generating asymmetric price formation and reducing producer margins.

Average transaction costs were estimated at 12–18% of final sale value due to:

- Information asymmetry
- Lack of collective marketing
- Transport inefficiencies
- Informal sanitary compliance

Horizontal coordination among producers was weak, and vertical coordination mechanisms were absent.

C. Productivity Gap Quantification

A comparative efficiency analysis between traditional and semi-technified production systems showed a significant productivity differential.

Table II - Productivity Comparison

Indicator	Traditional System	Semi-Technified Benchmark	Gap (%)
Animals per reproductive cycle	2.6	3.5	-25.70%
Mortality rate	18%	10%	+80% higher mortality
Feed conversion efficiency	1.0 (baseline)	1.25	-20% efficiency
Net income per cycle	Baseline	+32% projected	—

The productivity gap ranged between 25–35%, confirming the existence of a structural efficiency deficit.

D. Integrated Intervention Simulation

A systemic intervention model was simulated combining:

- Technical upgrading (improved housing, feed management, breeding control)
- Associative commercialization
- Access to formal credit
- Institutional coordination

Projected impacts over a three-year horizon include:

Table III - Projected Impact of Integrated Model

Indicator	Baseline	Projected	Variation
Productivity per unit	100 (index)	130–135	+25–35%
Net household income	100	120–125	+20–25%
Transaction costs	100	80	-20%
Formal market participation	18%	45%	+150% increase

The simulation demonstrates that productivity improvements alone are insufficient; institutional coordination and associative governance produce multiplier effects.

E. Reduction of Transaction Costs

Through collective commercialization mechanisms, economies of scale in transport and negotiation were estimated to reduce transaction costs by approximately 20%, primarily through:

- Shared logistics
- Direct negotiation with slaughterhouses
- Improved information flow

This directly increased producer margins and reduced dependency on intermediaries.

F. Governance Strengthening Outcomes

The strengthening of social capital through associative structures generated measurable impacts:

- Increased collective sales volume (+40%)
- Improved price negotiation capacity
- Greater access to technical assistance

Social capital index increased from 0.32 to a projected 0.55 under coordinated governance.

G. Composite Impact on Livelihood Capital Index

Under the integrated intervention scenario, the composite LCI improved from 0.41 to an estimated 0.63, indicating a transition from vulnerability to moderate resilience.

- The improvement was driven primarily by gains in:
- Physical capital (infrastructure upgrade)
- Financial capital (credit access and income increase)
- Social capital (organizational strengthening)

H. Systemic Interpretation

The empirical evidence confirms that isolated productivity interventions are insufficient to generate structural transformation. Instead, the integration of livelihood asset strengthening with value chain upgrading produces compounded improvements in economic resilience and market participation.

The results validate the hypothesis that systemic articulation of territorial assets and value chain redesign generates measurable and scalable impacts in small-scale livestock systems operating under structural vulnerability.

VI. Conclusions

This study empirically demonstrates that the low competitiveness of the guinea pig value chain in the district of Huachis is not solely attributable to technical production constraints, but rather to a structural combination of deficiencies in productive assets, weak institutional coordination, and elevated transaction costs.

The territorial diagnosis based on the Sustainable Livelihoods Framework (SLF) enabled the quantification of a Composite Livelihood Capital Index (CLCI) with an initial value of 0.41 on a 0–1 scale, revealing a medium-to-high level of structural vulnerability. The most critical deficiencies were identified in financial capital (0.33) and social capital (0.32), confirming that the primary bottlenecks extend beyond technological limitations to include restricted access to formal credit and weak associative structures.

The value chain analysis conducted using the Value Links methodology revealed a highly fragmented structure in which more than 80% of producers operate as small-scale family units, with limited vertical integration and strong dependence on intermediaries. This configuration generates estimated transaction costs ranging from 12% to 18% of the final sales value, significantly compressing net margins and reducing producers' bargaining power.

The comparison between traditional and semi-technified systems identified a productivity gap between 25% and 35%, reflected in lower feed conversion efficiency, mortality rates up to 80% higher than regional technified benchmarks, and reduced output per reproductive cycle. This productivity differential translates into an estimated 20% to 25% gap in net household income per production unit.

The simulation of an integrated intervention model—combining technological upgrading, organizational strengthening, improved access to credit, and associative marketing—projects productivity increases of up to 35%, transaction cost reductions of approximately 20%, and an expansion of participation in formal markets from 18% to 45% within a three-year horizon.

At the aggregate level, the Composite Livelihood Capital Index could increase from 0.41 to 0.63, representing a relative improvement of more than 50% in structural resilience, thereby signaling a transition from a condition of productive vulnerability to a more sustainable territorial economic structure.

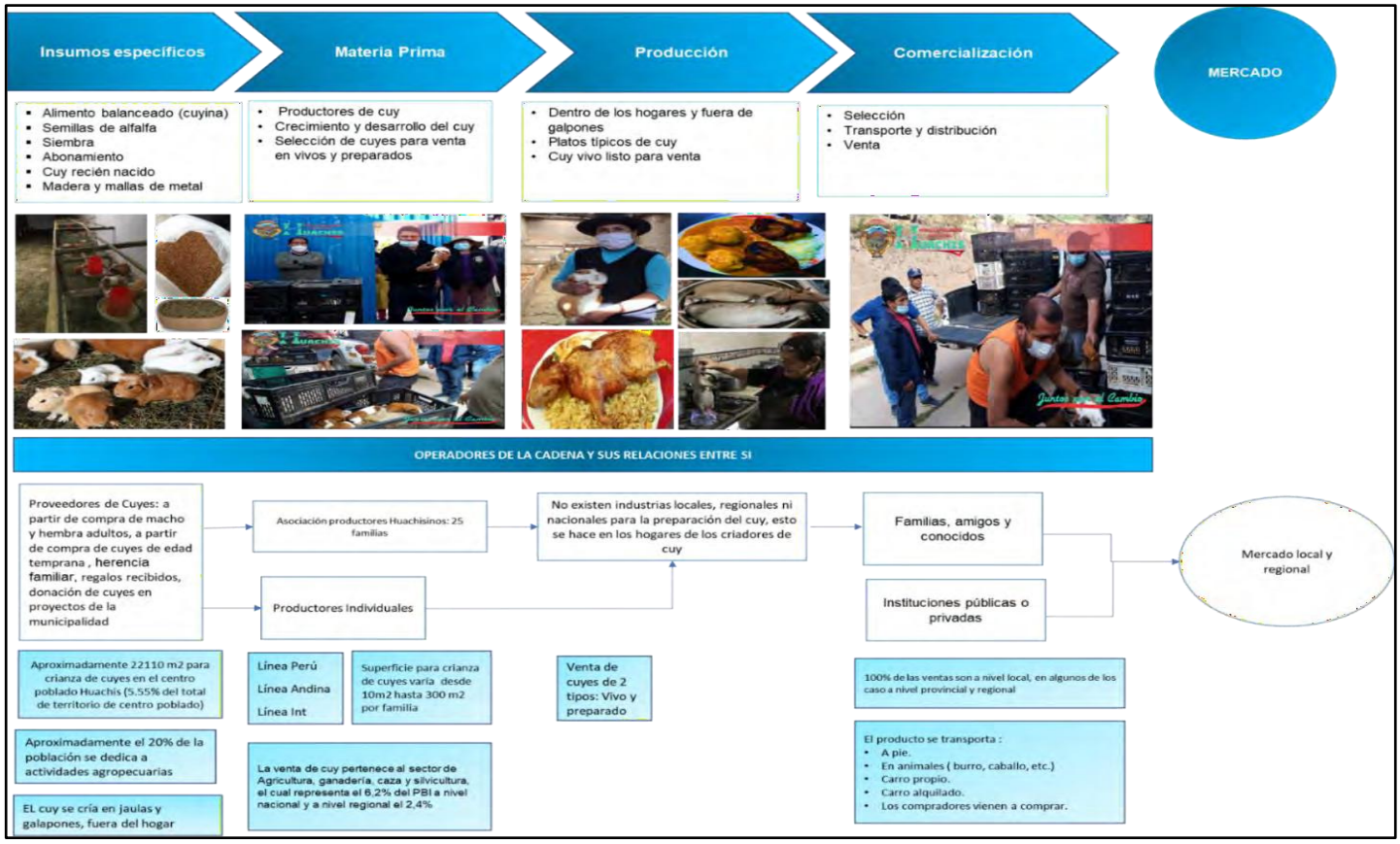

Fig. 5 - Guinea Pig Value Chain in Huachis

The findings confirm that isolated interventions focused exclusively on zootechnical improvements are insufficient to transform small-scale livestock systems.

In contrast, the integration of multidimensional asset diagnostics with strategic value chain redesign generates measurable synergistic effects on productivity, income generation, and local governance.

From a systemic perspective, the evidence suggests that productive upgrading must be accompanied by strengthened social capital and improved institutional coordination mechanisms to ensure long-term sustainability. The combined methodological approach therefore constitutes a replicable model for other small-scale agricultural value chains operating under conditions of structural vulnerability.

In summary, this research demonstrates that aligning territorial assets with value chain governance not only enhances technical efficiency but also significantly improves value capture capacity among smallholders, directly contributing to rural poverty reduction and territorial economic resilience.

In its current configuration, the guinea pig value chain in the district of Huachis exhibits a fragmented and weakly articulated structure, characterized by high production atomization, limited horizontal coordination among producers, and a pronounced dependence on intermediaries during commercialization stages. This structural arrangement generates technical inefficiencies, elevated transaction costs, and a reduced capacity for value capture at the household level. The absence of formal governance mechanisms and functional integration across value chain segments constrains opportunities for productive upgrading and limits access to differentiated market channels (see Figure 5).

Through the multidimensional diagnosis grounded in the Sustainable Livelihoods Framework, structural gaps across the five livelihood capitals were systematically identified, along with their direct implications for the competitive performance of the chain. The integration of this territorial asset analysis with strategic value chain redesign—implemented through the Value Links methodology—enabled the formulation of an articulated value chain architecture. Within this redesigned configuration, improvements in productive assets, organizational strengthening, and institutional coordination operate synergistically.

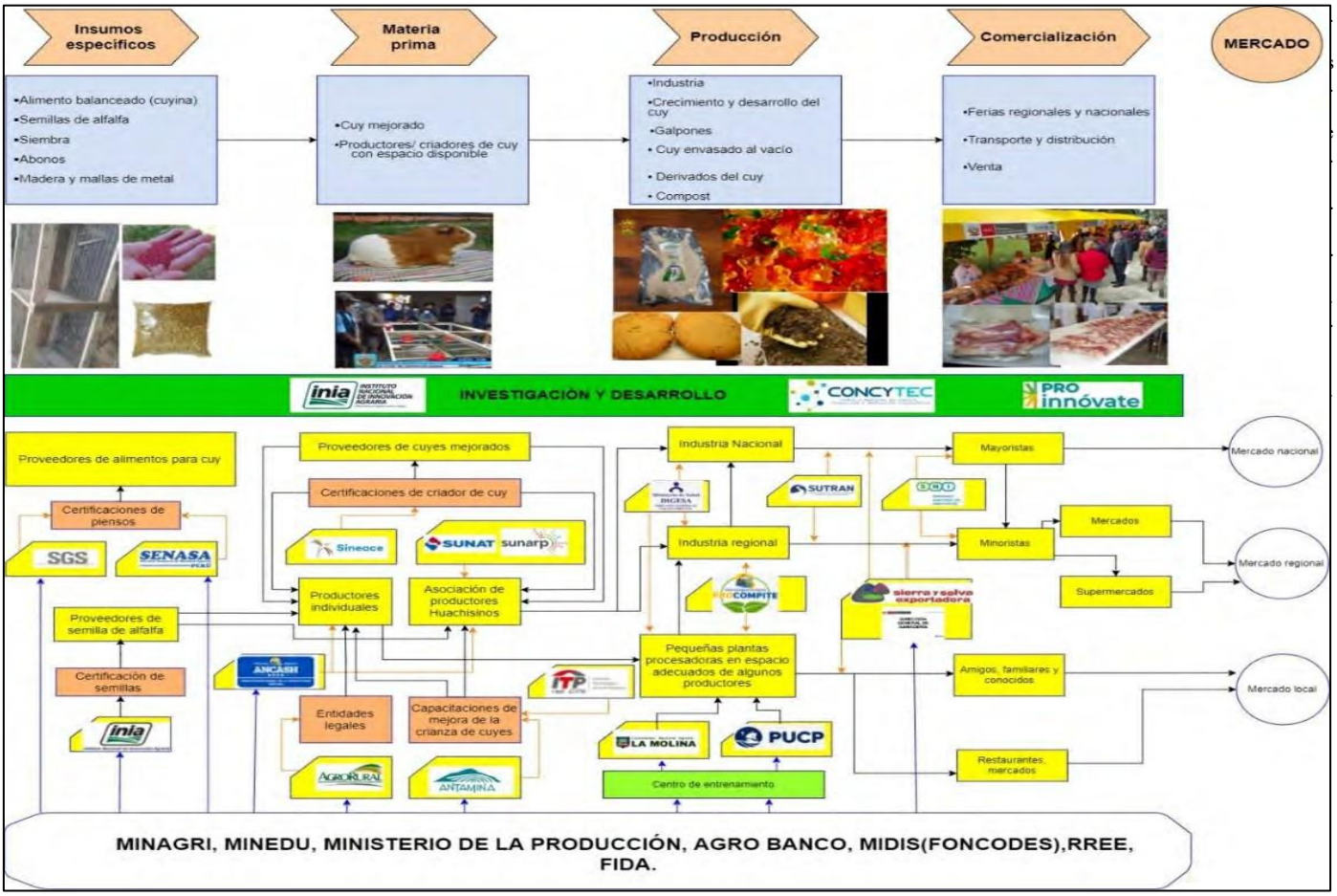

Fig. 6 - Articulated Value Chain of Guinea Pig Production

The resulting structure enhances technical efficiency, reduces transaction costs, and strengthens bargaining power, thereby establishing structural conditions for sustainable competitiveness and improved value capture by local producers (see Figure 6).

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