

Empirical Evidence Transformation into Local Agro-Governance Pathways for Enhanced Agro-Productivity in Rural Mid-Hills of Nepal

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Abstract

Agriculture with livelihood is vital for the Nepalese economy. The primary sector contributes approximately 27% to the national GDP and acts as a safety net in economic woes. However, this sector faces various challenges. State restructuring from unitary to federal governance enables sustainable and resilient agro-governance even from local levels. Thus, local agro-governance has a crucial role in identifying policy constraints and enhancing land productivity. Thus, this study tries to explore different observed variables of local agriculture governance and agriculture production. Structured questionnaires were distributed to farmers and primary data was collected (285 samples) from rural mid-hill; Tamakoshi Rural Municipality, Dolakha for the study. This quantitative research design integrates diverse constructs encompassing agro-production and local agro-governance while estimating land productivity through Structural Equation Modeling (SEM) employing multiple regression analysis. The competencies of policy implementation hinge primarily on socioeconomic indices; the findings highlighted the mechanization policies, farm inputs, efficient use of production factors, and governance enrichment to enhance land productivity. Thus, it's crucial to minimize policy shocks and implement targeted and tailored approaches with multi-stakeholder engagement. Focusing on agro-specific and sensitive long-term strategies; it's essential to pursue state and non-state actors' governing pathways to enhance land productivity and foster comprehensive agro-development.

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1. Introduction

The agriculture sector (agriculture, forest, and fisheries) remains the primary sector of the Nepalese economy supporting 29,164,578 population among them 48.9 percent are males and 51.1 percent are females (NSO, 2023). Nepal has raised the bar for defining poverty: compared to the old poverty line from 2011 to 2023, the new line raises the bar by 70% to NPR 72,908 showing 20.27% of the population being under the line of poverty. The urban areas have slightly lower poverty incidence (18.34%) than that of rural areas (24.66%) (NLSS, 2022-23). In the Himalayan foothills and rural areas,

agriculture underscores the economy employing approximately 65% of the population. Despite being a cornerstone of the economy, agriculture's productivity remains stagnant due to disjointed governance across pre- and post-farming activities, resulting in reduced benefits for the populace. The local government may foster an institutional bricolage, for implementing agro-policies, improving socioeconomic indices, and enhancing environmental sustainability. Despite Nepal's rich agricultural potential; lower production and productivity, inefficient governance,

inadequate farm inputs, climate change, and global warming have led to stagnant progress (MoALD, 2020).

In the agricultural realm; over the course of decades, it has been stressed that both formulating and implementing agricultural development policies are vital for improving productivity and fostering growth (Abro et al., 2014; Mueller & Mueller, 2016). Similarly, agriculture diversification and commercialization (Pradhanang et al., 2015), and reduction of poverty via agro-development (World Bank, 2016; Corral et al., 2017) are also crucial. Correspondingly, efficient governance for agricultural development (Saint et al., 2017; Sidibé et al., 2018), agriculture development to resolve conflicts (Singh, 2012), and environment-friendly and Climate-Resilient Agriculture: CRA (Blanco et al., 2017; Babu et al., 2018) seem cross-cutting in recent days.

Implementing appropriate agricultural policies and efficient governance is crucial for rural development in Nepal (Chaudhary, 2018). Agro-growth serves as the precursor to unprecedented poverty reduction and a vital chariot for the growth of pro-poor (Gauchan, 2008). Aligned with prevailing constitutional provisions and legal frameworks, the transformation of unitary governance into three tiers: the federation, provinces, and local governments; since the promulgation of the new constitution in 2015 has provided opportunities to enhance agro-governance practices, even at the local level, ensuring sustainability and resilience (FIARCC, 2016). Likewise, many scholars have made substantial contributions to exploring diverse viewpoints on agricultural development in Nepal: such as factors influencing agricultural mechanization (GC et al., 2019) and agro-productivity and reduction in poverty (Devkota & Upadhyay, 2013). Similarly, various facets of rice cultivation and productivity were examined by Thapa et al. (2020); Bedari et al., (2020); Upreti (2010); Basnet (2010a & 2010b) in their research. Equally, rice production policies, mechanization, and use of ICT were reviewed by respectively Bhandari et al. (2017) and Sigdel et al. (2022a & 2022b). Similarly, agro-policies, institutions, and functions were reviewed within the framework of sectoral restructuring in Nepal (Bishwakarma, et al. (2021); Tamang et al. (2020); Khanal et al. (2020). Likewise, Kharel et al. (2022) reviewed appropriate agro-practices for food safety and agro-sustainability in Nepal. Chhetri et al. (2023) studied forest, agriculture, and migration: contemplating the future of forestry and agriculture in the middle hills of Nepal. Nyaupane (2023) studied the contribution of expenditure to agriculture growth in Nepal. Bhatt et al. (2024) made a comparative economics of main season and spring rice production in Kanchanpur district, Nepal. Pokhrel et al. (2024) assessed the economic and energy use efficiencies of hybrid and inbred rice varieties through the omission-plot technique in Lamjung, Nepal. Such efforts have demonstrated significant benefits in promoting agricultural development. As a result, local governance and related institutions in Nepal offer promising opportunities to tackle the challenges of agro-development effectively.

Based on the targeted and tailored approaches for local agriculture development, multiple facets should be juxtaposed properly. Thus, it's crucial to align agro-production and local agro-governance in empirical research based on the newly federalized context of Nepal. This study aims to explore how local governance influences agricultural productivity, particularly in the rural mid-hills of Nepal. It employs a quantitative approach to analyzing variables of agriculture production and local agriculture governance focusing on enhancing land productivity in paddy production. Additionally, it fills research voids and offers practical solutions to policymakers and stakeholders, thereby shaping Nepal's local agricultural facets.

The paper is outlined into major four chapters to accomplish such aims. The Introduction (study location, sample selection including methods of data collection, and methodology are explained in the first section. The materials and methods (analytical framework, measurement of variables, and coding details) are explained in the other section. Subsequently, the Results and discussions (coefficients, and explanations) are presented with some cross-validations. The last chapter is Conclusion; which concludes with the key findings and pragmatic implications for local agricultural development and sustainability.

1.1 Study Location

The study location was Tamakoshi Rural Municipality of Dolakha district in Bagmati Province. Dolakha has a Latitude 27°47'37.68" North to Longitude of 86°11'03.48" East, which is located in the middle of the Nepalese territory. It covers an area of 2191 km² (Survey Department, 2023), with a population of 172,767 (males 48.5% and females 51.5%). The average family size is 3.49, the population density is approximately 79 persons per km², and the annual population growth rate is reported as 0.74% (NSO, 2023).

Within Dolakha district, Tamakoshi Rural Municipality is situated in the southern part, characterized by a temperate and humid sub-tropical climate. The primary occupation in this RM is subsistence farming, although some individuals also engage in commercial crop harvesting, foreign employment, and construction work. The Tamakoshi River plays a crucial role as a water source for irrigation in several wards. This study covers all seven wards of Rural Municipality. The political and administrative map of Nepal locating study area is shown in Figure 1.

Table 1. Socio-demographics of study location

Location	Local Level	Ward No. and Villages	Total Population		Area (km ²)
			Male	Female	
Bagmati Province, Dolakha	Tamakoshi Rural Municipality	1 (Bhirkot)	1030	1077	17.48
		2 (Jhule)	819	891	9.35
		3 (Japhe)	1489	1513	12.7
		4 (Malu)	918	1047	8.81
		5 (Shahare)	1109	1263	13.5
		6 (Chyama)	1035	1104	8.26
		7 (Hanwa)	917	951	19.05
Total			7317	7846	89.15

Source: NSO (2023)

Table 1 summarizes the brief socio-demographics and geographical information of the study location. The total population of Tamakoshi RM, Dolakha is 15,163 (male 48.3% and female 51.7%). The sex ratio is 93.26 males per 100 females and the literacy rate is 74.0% (male 83.5% and female 65.3%). The total number of households is 4,485, the average family size is 3.38, and the population density is 99 persons per km² (NSO, 2023).

Figure 1. The political and administrative map of Nepal (with study area located by author)

Source: Survey Department, 2023

1.2 Sample Selection

The total number of farmer families in the study location noted was 4177, among them 2526 grow paddy (NSO, 2023a). The structured questionnaires were distributed (March 2023) to the farmers randomly and 285 samples were collected with a response rate of 87.7%. The data was collected from each ward (1-7) based on the information provided by the Rural Municipal Office. The number of samples collected from wards 1-7 respectively is 41 (14.4%), 34 (11.9%), 59 (20.7%),

34 (11.9%), 34 (11.9%), 50 (17.5%), 33 (11.6%). As Ward No. 3 has the largest population density among the seven wards: thus, more samples were collected from this ward. Field observation illustrates that more people are involved in farming and have surplus agricultural land for farming. In all the wards, the population of women is greater than males, but in this survey sample population of women is less than that of men. This may indicate that the women are more engaged in household activities and other stuff. This fact is also supported by the data given by the National Sample Census of Agriculture Nepal, 2021/22.

2. Materials and Methods

A quantitative research model was designed by integrating observed and latent variables. Structural Equation Modeling (SEM) using the software IBM AMOS V23 employing multiple regression analysis was used to scrutinize the impact of latent variables on land productivity.

2.1 The Analytical Framework

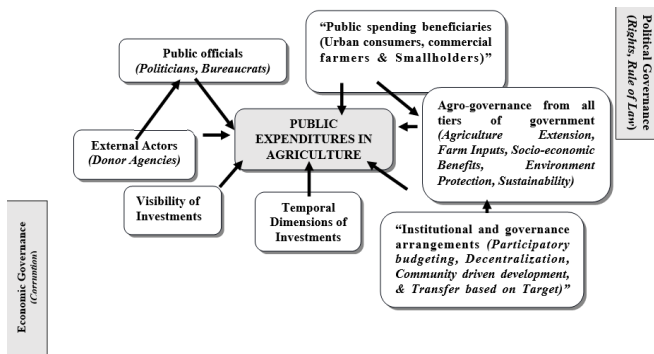
The study is based on the Mogues and Erman (2016) framework (cited by Goyal & Nash, 2017, p. 271), and contextual improvisation relying on Nepalese circumstances (Figure 2). Four prominent institutional arrangements included in their study are participatory budgeting, community-driven development programs, decentralization, and targeted transfers. Targeting spending in more unequal societies, and also based on political affiliation, creates vulnerability to capture. Over-representation, elite capturing, and political targeting are major hurdles in transfer programs (Goyal & Nash, 2017, p. 275). Thus, participatory budgeting, community-driven development programs, and decentralization have actual effects on responsiveness and pro-poor resource allocation (Goyal & Nash, 2017, p. 271).

By considering the spirit of the Nepalese constitution, fruitful coordination and cooperation among all tiers of government is the legal benchmark. The federation is responsible for integrated agro-ecological mapping (Lillesø et al., 2005; Ranjit et al., 2006; Karki et al., 2020; Khanal et al., 2020; Subedi et al., 2022) and the development of overall agricultural policies. On the other hand, the provinces deliver specific and sectoral programs based on the targeted geographical potential (Oldekop et al., 2018; Lewison et al., 2019; Shrestha et al., 2020). Local levels, being the governments in the vicinity of people, are accountable for providing farm inputs, delivering agriculture extension services (FIARCC, 2016), and promoting agriculture from the grassroots by considering production and productivity (MoAD, 2014), environment-friendly agro-activities (Basnet, 2012), and sustainable agro-practices (MoALD, 2020).

The significance of elasticities in the Nepalese milieu can be analyzed by incorporating agro-governance from all tiers of government into the 'Framework for Political Economy Determinants of Agricultural Public Spending' by Mogues and Erman (2016). Various dimensions of agro-governance in each tier of government have a mutual relationship with

institutions and governance arrangements. The functions and impacts of public spending cover smallholders', commercial farmers, customers, and urban consumers as well. Thus, political economy determinants and agricultural public spending framework can be improvised in the Nepalese context as follows:

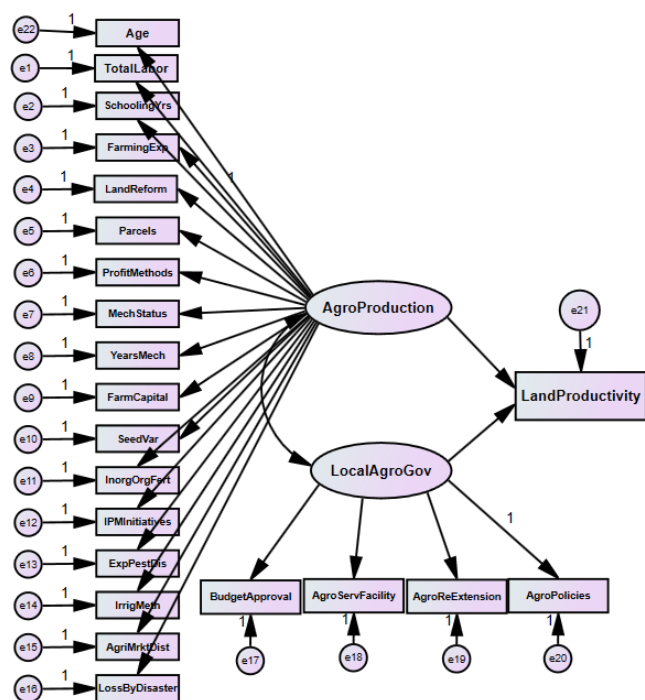
Figure 2. Improvisation of mogues and Erman’s framework



Source: Author’s improvisation in the Nepalese context based on existing laws and pertinent literature

Based on the conceptual framework (Figure 2) current study model was designed. The model consists of seventeen observed variables that are linked with the latent construct of agro-production, while another latent variable, local agro-governance, is characterized by four observed variables, and land productivity serves as an endogenous variable (Figure 3).

Figure 3. Path diagram of the study



2.2 Variables Description

Observed variables of agriculture production were selected by an extensive review of pertinent literature and existing rules and regulations. Similarly, local agricultural governance variables were extracted from the Unbundling Report (FIARCC, 2016). The decision to prioritize agricultural development over the livestock regime for future studies was made among various local agro-constitutional rights. The agriculture development was chosen, leaving the livestock regime for future studies, among the constitutional rights of local levels related to agriculture. The agriculture development was chosen, leaving the livestock regime for future studies, among the constitutional rights of local levels related to agriculture. The measurement of variables is shown in Table 2.

2.2.1 Agriculture Productivity

The selection of diverse productivity measures and their associated factors depends on the specific purpose for which productivity is being measured. The ratio of output volume to inputs is productivity (OECD, 2001). It is a rise in the per capita output of agricultural produce within an economy during a given period. Many scholars studied agro-productivity such as Abro et al. (2014) examined family income, farm capital, extension services, land-labor ratio, as well as land and labor productivity for productivity growth and poverty reduction in rural Ethiopia. Ivanic and Martin (2018); Awoyemi et al. (2017); and Kaur (2013) analyzed the productivity and growth of people. Devkota and Upadhyay (2013) explored multiple extents of poverty reduction and agriculture productivity, and the constraints in the Nepalese context have been identified. Similarly, Nyaupane (2023) studied the contribution of expenditure to agriculture growth in Nepal.

Basnet (2012) underscored the central role of rice/paddy (*Oryza Sativa L.*) in the food basket for more than fifty percent of the world's population as a major staple food; thus, focused on productivity studies. Coping with current global food demand, rice production must increase by 70% by 2050 (Basnet, 2012), which depends on multiple factors such as plot preparation, seeds (age, type, numbers, planting geometry), fertilizers, irrigation, insecticides, and temperature all together integrated into rice productivity.

In this research, land productivity is studied by SEM employing a multiple regression model. The measure of land productivity (YieldQt./Rp.) employed quantifies the production of rice in Quintals (Qt.) per unit area of cropped land in Ropani (Rp.) (Abro et al., 2014; Kapri & Ghimire, 2020). Farmer's age can significantly influence the mindset in their approach to supplying labor and also managing rice farms, thereby impacting productivity (Fitri et al., 2022). Thus, agricultural tasks performed by minors are omitted from consideration, with a focus on major-scale activities, reflecting a gender-based division of labor within the

agricultural process. Consequently, this study recognizes and values the equal participation of both males and females, acknowledging their respective socio-cultural roles and multi-faceted contributions. Given that, Sam (2013) explained productivity as the ratio of total farm output to total input value in farm production.

The National Sample Census of Agriculture Nepal (2021/22) entails some farmers' information on Tamakoshi Rural Municipality. The 3984 farmer families have agriculture as a major, and 283 have non-agriculture income sources. Similarly, 2203 farmer families do not get sufficient food for the whole of the year by the annual income of agriculture produces (NSO, 2023a). As cropped land has been decreasing day-by-day due to new city development, urbanization, and haphazard land-use policies in developing democracies. Furthermore, increasing agro-production, and productivity considering production factors is of ultimate need. Thus, this research considers productivity studies by focusing on agro-production and local agro-governance construct together.

2.2.2 *Agro-Production*

This latent variable consists of seventeen observed variables of different categories such as farming practices, mechanization, farm inputs, and CRA. The level of education can affect the adoption and innovation of new technologies, farming experience affects the ability to plan farming (Fitri et al., 2022). The significance of human resources in agricultural operations was emphasized in the National Agricultural Policy (2004). Farming techniques and methods of increasing agricultural profits hold equal significance (Abro et al., 2014). The agricultural literacy level of farmers is a critical factor influencing their decision-making ability and the implementation of better farm activities.

Land reform techniques are central to farming activities. CBS (2013) defined land being used as agricultural holdings (Chalan gareko jagga) and land parcels. Choudhary et al. (2022), and Upreti (2010) analyzed land fragmentation, the number of parcels within the cropped area, and improved soil chemistry in paddy farming leading to enhanced productivity. Similarly, the study of Devkota and Upadhyay (2013) establishes a positive output of land reform on productivity. Basnet (2012) also critically states "Grow paddy with soil fertility, wheat with fertilizers."

Farm mechanization enhances agricultural productivity through the use of tools, implements, and machinery (FAO, 2018) and significantly promotes higher output and profitability (Ghosh, 2010). Mechanization can be employed when a high land-labor ratio and be a panacea for a scarce labor force (GC et al., 2019; Devkota & Upadhyay, 2013; and Upreti, 2010); thus, essential for modern agriculture (Rasouli et al., 2009). Nepal's National Agriculture Policy (2004) emphasizes the adoption of machinery such as tractors, mini-power tillers, other heavy machines, threshers, seeders, motorized pumps, and sprayers to advance farm mechanization. Abro et al. (2014) studied the effect of the total

number of machines as farm capital assuming farm assets are homogenous among households.

CBS (2013) categorized seeds, fertilizers, and pesticides as farm inputs; and seed use patterns of local seeds or/and high-yield seeds at the sowing time are considered. Seed varieties and cultivars underscore the agricultural harvests (Kaur, 2013; Abro et al., 2014; Jones et al., 2017 and Goyal & Nash, 2017, pp. 189-191). By considering the pivotal role of seeds in farming Basnet (2012) quotes "Healthy seedlings are responsible at least for half of the yields." Fertilizer use patterns of chemical/minerals/inorganic fertilizers (Urea, DAP, MoP) and organic/local fertilizers (Compost, FYM), or mixed approaches are studied in Nepal.

Similarly, Integrated Pest Management (IPM) incorporates the use of various methods including pesticides, fungicides, fumigants, herbicides, rodenticides, and other materials to control pests and diseases (CBS, 2013). The consistent challenge of timely access to seeds, fertilizers, and pesticides in Nepalese agriculture, whether due to their unavailability or inadequacy, directly impacts the yield of agricultural produce. Irrigation is defined as intentionally providing water on land, it does not include natural floods by rain or overflows from rivers but includes meticulous collection and use of rainwater (CBS, 2013). The ponds, rivers, or lakes (by pumping or by gravity), reservoirs or dams, boring or tube wells, others (springs and wells), and mixed sources are major means of irrigation.

The duration of one-way travel ranged from ten minutes to three hours, and transportation methods encompassed travel by rickshaw, bicycle, tempo or motorcycle, bus or car, on foot, or a combination up to the closest agriculture market (CBS (2013). Access to the market is also essential for enhancing the annual farm income of families.

Basnet (2012) argues that the risk of climate change and its multiplier effect threaten water resources, food security, and agricultural systems in the coming days. The technologies resilient to the changed environment, Agricultural Systems Modeling, and investment in CRA must be the agricultural frontier (Basnet, 2012; Blanco et al., 2017; Babu et al., 2018). Weather insurance is argued to be more crucial than crop insurance in preventing production loss from disasters, given the dismal results of crop insurance worldwide. Weather insurance should be promoted by the government as a better management tool because of its objectivity, transparency, and administrative ease (Kaur, 2013). Nevertheless, Basnet (2010a) argues for environmental sustainability while chasing enhanced productivity.

2.2.3 *Local Agro-Governance*

This latent variable consists of four different observed variables such as timely budget approval at the Rural Municipality (RM), the agro-service facility provided, agri-research and extension, and agro-policies for sustainability. Ensuring adequate agricultural incentives for farmers is crucial in developing democracies (Kaur, 2013). Sidibé et al., (2018); Barkley and Barkley (2020, pp. 12-15); Khanal et al.

(2020); Bishwakarma et al. (2021) also highlighted the requirements of farmers’ subsidies. Mogues and Erman (2016); Jones et al. (2017); Goyal and Nash (2017, p. 271); and Swinnen (2018) advocated the political economy and necessity of efficient public spending in agriculture.

Nepalese farmers receive support from numerous government policies that have been enacted. Constitutional jurisdiction (Schedule-8, Schedule SN. 15 & 18) envisioned agricultural incentives channeled through local levels, yielding significant production outcomes and fostering positive agro-governance impacts. Agricultural extension (outreach, training, farming techniques, awareness, and support) is under the jurisdiction of local governments (FIARCC, 2016). Local levels are governments in the vicinity; they comprehend the necessities, delivering effective services to the people through appropriate governance setups. Timely approval of annual budgets by local levels and the formulation and implementation of appropriate agro-policies are crucial for agricultural development and sustainability.

Table 2. Measurement of variables

Latent Variable	Observed Variables /Indicators	Items and coding details
Agro-production	Total labor [TotalLabor]	Total labor force (male and female)
	Schooling Years [SchoolingYrs]	Total schooling years of the Head of Households (Higher Secondary or/and above: 12, SEE/SLC: 10; Primary Level: 5, Non-formal education: 3 (Abro et. al, 2014), Not been to school: 0)
	Farming Experience [FarmingExp]	Total farming experience (Years)
	Land Reform [LandReform]	Improving soil fertility by applying methods beyond tillage, may include land pooling and consolidation (1: Yes, 0: No/Just Tillage)
	Parcels [Parcels]	Number of parcels within the cropped area
	Profit-making methods [ProfitMethods]	Any one method for making agricultural profits known (models of productivity, value-addition, creating value chain, others-if) (1: Yes, 0: Not at all)
	Mechanization Status [MechStatus]	At least a machine (tractor, mini-power tiller, motorized pump, thresher) used on the farm
	Years of mechanization [YearsMech]	Total years of mechanization

Local agro-governance

Farm Capital [FarmCapital]	Total number of machines used in farming (farm capital: Abro et al., 2014)
Seed Varieties [SeedVar]	Uses of high-yield seeds (also mixed) (1: Yes, 0: Local Seeds)
Inorganic Fertilizers [InorgOrgFert]	Uses of inorganic and organic fertilizers (mixed)
IPM Initiatives [IMPInitiatives]	Implementation of Integrated Pest Management initiatives prioritized by rural municipality (1: Yes, 0: Otherwise)
Expenses in Pests [ExpPestDis]	Annual expenditure (in NPR) on pest and disease control.
Methods of Irrigation [IrrigMeth]	Water deliberately supplied, excluding rainfall, through canal systems or other methods. (1: Yes, 0: Rainfed farming)
Agriculture Market Distance [AgriMrktDist]	Distance to the nearest agriculture market (km)
Loss by Disaster [LossByDisster]	Natural disasters and climatic hazards causing significant losses (also partial) in agricultural fields and crop yields (1: Yes, 0: Not at all)
Budget Approval [Budget Approval]	Timely approval of the annual budget by the Rural Municipality (1: Yes, 0: Otherwise)
Agro-service Facility [AgroServFacility]	Subsidies and/or at least an agro-service (Outreach, Agro-technician field inspection, and others-if) received by farmers (1: Yes, 0: Not at all)
Agri-research and Extension [AgroReExtension]	Agricultural research and extension provided by the RM (Likert Scale Question)
Agricultural Policies [AgroPolicies]	Agricultural policies employed by RM and sustainability for agricultural development (Likert Scale Question)

3. Results and Discussions

Eighty-three percent of males and sixteen percent of females engaged in the farming process represent females are more engaged in pre-specified roles (socio-cultural) including household activities. The majority of farmers have completed just primary education, and the average years of farming experience is 17.6 (range: 5 to 36) years. The level of education (formal, non-formal) significantly enhances socio-economic status, particularly concerning farm experiences, thereby facilitating better farm decisions. Likewise, average farming experience shows majority have been farmers for a

long. Eighty-two percent of farmers do not have another occupation and rely on subsistence farming, complementing the sample selection in the study. Beyond the catchment of local government subsidy programs; five percent of farmers still use just animal-based power for farm reform activities, which justifies the role and influence of socio-economic indices for the adoption of mechanization. The average distance to the nearest agricultural market is 6.2 km (range: 3 to 9) showing farmers are still on foot for accomplishing many of the pre-and post-farm activities. Despite agro-services and extension facilities harvesting paddy once a year might signify diversification into other, and, commercial crops, labor shift dynamics, and the rise of other sectors.

The frequency analysis of agri-research, incentives, and extension provides a mean (M) of 3.32 and a standard deviation (SD) of 0.77. Similarly, for overall agricultural policies, the M = 2.43 with an SD = 0.79. The higher values in the case of agri-research, incentives, and extension represent the pragmatic efforts of the rural municipality for agricultural development and sustainability.

Structural Equation Modeling (SEM) was performed for the multiple regression analysis. The p-value (0.99), greater than the significance level (0.05) obtained by the Kolmogorov-Smirnov Test, fulfills the criteria of normality. The preliminary analysis was conducted to ensure the goodness of fit model. The obtained values are shown below (Table 3).

Table 3. Model fit tests

Model Fit Parameters	Value	Info
Chi-Square/df	2.40	Ideal
GFI	0.92>0.90	Fit
AGFI	0.83>0.80	Fit
TLI	0.92>0.90	Fit
CFI	0.96>0.90	Fit
IFI	0.96>0.90	Fit
NFI	0.93>0.90	Fit
RMSEA	0.072<0.08	Fit

The values of Chi-Square/df, GFI, AGFI, TLI, CFI, IFI, NFI, and RMSEA, also show the achievement of ideal values, and most of the model eligibility tests in this study indicate an excellent fit of the model (Collier, 2020, pp. 66-68). The regression weights of the observed variables of agro-production and local agro-governance, with productivity, are presented in Table 4.

Table 4. Summary of regression weights

Items	Variables	Standardized Estimate	S.E.	C. R.	P	
YearsMech	<---	AgroProduction	.225	.023	9.880	***
MechStatus	<---	AgroProduction	.015	.004	4.036	***
ProfitMethods	<---	AgroProduction	.044	.006	7.362	***
Parcels	<---	AgroProduction	.317	.022	14.570	***
LandReform	<---	AgroProduction	.024	.005	4.580	***
FarmingExp	<---	AgroProduction	-.235	.085	-2.771	.006**
SchoolingYrs	<---	AgroProduction	.135	.062	2.168	.030*
TotalLabor	<---	AgroProduction	1.000			
FarmCapital	<---	AgroProduction	.498	.025	19.883	***
SeedVar	<---	AgroProduction	.042	.007	6.189	***
InorgOrgFert	<---	AgroProduction	.069	.002	41.103	***
IPMInitiatives	<---	AgroProduction	.006	.002	2.511	.012*
ExpPestDis	<---	AgroProduction	180.145	12.983	13.875	***
IrrigMeth	<---	AgroProduction	.018	.005	3.438	***
AgriMrktDist	<---	AgroProduction	-.029	.022	-1.339	.181
LossByDisaster	<---	AgroProduction	-.013	.009	-1.550	.121
AgroPolicies	<---	LocalAgroGov	1.000			
AgroReExtension	<---	LocalAgroGov	.795	.067	11.901	***
AgroServFacility	<---	LocalAgroGov	-.343	.054	-6.369	***
BudgetApproval	<---	LocalAgroGov	-.352	.064	-5.480	***
Age	<---	AgroProduction	.416	.121	3.435	***
LandProductivity	<---	AgroProduction	.624	.012	51.262	***
LandProductivity	<---	LocalAgroGov	.077	.064	1.200	.230

Note: *p < 0.05, ** < 0.01, and, ***< 0.001, Standard Error (S.E.), Critical Ratio (C.R.)

The mechanization status (0.015), years of mechanization (0.225), and farm capital (0.498) have positive and significant effects on agro-production. The previous studies: Sigdel et al. (2022b); GC et al. (2019); and Takeshima and Liu (2018) also support these results. The rural landscape and limited budgetary resources of local government may not support the massive mechanization.

Similarly, agricultural profit-making methods (0.044), land parcels (0.317), and land reform techniques (0.024) also significantly affect agro-production. This result finds additional support in previous studies conducted by Choudhary et al. (2022); Bedari et al. (2020); Thapa et al. (2020); Devkota and Upadhyay (2013); and Upreti (2010). Well-defined land parcels and land reform enable agro-production, thus enhancing agricultural profits. However, it is appropriate to consider tipping points by thoroughly comprehending and carefully recognizing all the underlying realities and factors in play: and sustainable land use (Sachs et al., 2019). Beyond the expectation farming experiences (-0.235) showed a negative and significant relationship. One possible reason could be that after federalization, the institutionalization of agricultural development at rural levels is still lacking; the cost of production, and improper post-production facilities: resulted in volatility in paddy farming among farmers.

The schooling years (0.135), and age of farmers (0.416) have a positive and significant relationship. Devkota and Upadhyay (2013) argue that dedicated farmers have an edge over naive ones, who may benefit from some agricultural training to improve efficiency. The education level of farmers plays a fundamental role in the farming process (Fitri et al., 2022); as better crop selection and rotation, optimizing resource management, innovation, appropriate farm decisions, adaptability, and resilience also get supported. Labor significantly influences production and productivity through its impact on the efficiency of agricultural operations, from planting and cultivation to harvesting and processing, by relating to the production factors. Thus, regression weight 1 was given to total labor, by considering the direct and proportional effect of the one-unit increase in the observed variable, the outcome increases by one unit.

The farm inputs (seed varieties (0.042), mixed fertilizers (inorganic and organic fertilizers, 0.069), Integrated Pest Management (IPM) initiatives by rural municipality (0.006), expenses on pests and disease control, irrigation methods (0.018) have a significant effect in agro-production. In this context, farmers made expenses independently and also received subsidies, including farm materials, from the rural municipality. Similarly, limited irrigation infrastructure and insufficient irrigation literacy among respondents in the study area may exhibit a weaker but significant relationship. Thus, it's reasonable that coefficients in the study might be weaker, despite still having a positive and significant relationship. This suggests that while subsidies may positively influence farm-related activities, the degree of impact may be moderated by the level of self-financing by farmers themselves. The timely unavailability of high-yield seeds and chemical fertilizers is a

prevailing, unresolved, and sluggish problem. The inadequacy of inorganic (chemical) fertilizers pushes farmers to choose alternative options, such as mixing with local or organic fertilizers, and also leads them to rely on Farm Yard Manures, compost, and other alternatives. Similarly, in the alternatives of adequate high-yield seeds farmers use local seeds. NSO (2023a) reveals that 846.8 Hectare land is irrigated within 2458.1 Hectare, which is just 34.5%. Similarly, 68% of farmer families use local seeds, 6.5% use high-yield seeds, and 25% use hybrid seeds. Just 13.7% use proper insecticides. While 16.2% of farmer families rely on local/organic fertilizers. While, 0.04% use chemical/inorganic fertilizers. In the absence of chemical fertilizers many of them (83.4%) use mixed fertilizers (NSO, 2023a). The descriptive analysis of this study also reveals similar results to National Sample Census of Agriculture Nepal (2021/22). These data and the study results related to all farm inputs align with prior research conducted by Choudhary et al. (2022); Gairhe et al. (2018); Devkota and Upadhyay (2013); and Timsina et al. (2012).

An insignificant relationship was found with the loss in yield by the disaster in this fiscal year. It's a well-known truth that favorable climatic conditions and weather are crucial for paddy farming. The farmer families who are informed about climate change and its effects within the rural municipality are 28.4% (NSO, 2023a). Thus, rural municipality should adopt appropriate mitigations for resilience; such as weather insurance (Kaur, 2013). In contrast, several factors can account for the negative relationship with the nearest agricultural market, including the relatively long average distance (6.2 km), lack of consistent public transport, low market integration, and improper pricing mechanisms. Under such circumstances, farmers may be motivated to explore alternative networks and rely on community marketing channels instead.

Appropriate agro-policies have a strong and direct relationship leading to proportional and sustained change in productivity levels, by considering broader socio-economic and environmental dynamics. Thus, regression weight 1 was assigned to agro-policies and sustainability, while formulating convenient modeling of this study. No Agricultural Service Centers (ASC) were established in the rural municipality, and the varieties of agro-services provided were not adequate; furthermore, even when received, they incurred costs to the farmers. The farmer families who received formal agricultural trainings are 1523 (NSO, 2023a), which is less in number compared to a total number of farmers. Thus, agro-service facilities (-0.343) have a negative significant relationship in this study. The agri-research and quality extension have a positive and significant (0.795) relationship with local agro-governance. The targeted and tailored approach employed by the rural municipality for the benefit of farmers results in better outcomes. These results are in alignment with previous studies by Choudhary et al. (2022); Tasmin and Yusriadi (2022); Awoyemi et al. (2017); Jones et al. (2017); Moguees and Erman (2016); Abro et al. (2014); Devkota and Upadhyay (2013); and Kaur (2013).

The trend of the black-box approach in project selection, approval of cumulative amounts from the assembly keeping line items unbundled, lacking proper implementation framework, and cosmetic monitoring and evaluation have been increasing. Although the Local Government Operation Act (2017) clearly mentions the Standard Operating Procedure of budget approval for a Fiscal Year at local levels in Nepal. This may be in thirst of gerrymandering and pork barreling, over-politicization of development agenda, and administrative incompetence. These approaches significantly diminish the active participation and meaningful engagement of people in governance. The rising trend of malpractices in the project cycle management and budgetary processes may have the potential to hinder the agriculture development and overall perception and satisfaction of farmers on local agro-governance and delivery. Thus, the negative relationship of timely budget approval by the rural municipality (-0.352) holds implications. Therefore, Goyal and Nash (2017, p. 232) state that ‘the shorter spectrum of actual spending and initially planned involve multiple partners in budget management, and as such, will require consensus building to achieve tangible progress.’ Hence, *ceteris paribus*, the yardstick competitions; a bottom-up approach (Salmon, 2019, pp. 1-7), always play a major role in navigating the future of democratic local governance.

The latent variable agro-production demonstrates a positive and significant relationship (0.624) with land productivity. However, while some observed variables show positive significance, others exhibit negative significance with local agro-governance. Notably, the latent variable, local agro-governance does not exhibit a significant relationship with productivity in this study. Recognizing that observed variables of local agro-governance also contribute to enhanced agro-production, reversely ground reality of agro-production values navigates local agro-governance policies. Thus, the complex interlinkage among these observed and latent variables underscores the necessity for active participation and meaningful engagement of multiple stakeholders in local agro-governance for agricultural development, resilience, and sustainability.

Thus, the improvisation of Mogue and Erman’s framework and study in the new federal structure of Nepal holds significance, focusing on agro-governance in all tiers, and, institutional and governance arrangements. Agro-specific and sensitive programs fall under multi-sectoral jurisdictions for comprehensive oversight and impact optimization. Sidibé et al. (2018) argue that ensuring effective multiscale governance heavily relies on the execution of appropriate laws formulated at the national level, serving as an eminent institutional mechanism. In many instances, the blanket approaches may not meet pragmatic circumstances and contradict local judgment (Sidibé et al., 2018). The federalized structures are facing similar issues in Nepal, numerous laws are yet to be formulated. Furthermore, Bishwakarma et al. (2021) mention that even after the enactment of new acts, there is a notable delay in the formulation and implementation

of supportive and concerned regulations, directives, and working procedures.

4. Conclusion

The influence and effects of observed variables on latent variables, and ultimately, the impact of latent variables on agricultural productivity was analyzed by Structural Equation Modeling and regression. The observed variables: mechanization (years and farm capital), farm inputs (organic and inorganic fertilizers, seed varieties, IMP), irrigation, labor force with appropriate schooling, and working-age potentiality of land reform techniques containing latent variable agro-production have a significant relationship with land productivity in the study area. Similarly, the observed variable of local agro-governance significantly predicted the latent variable; however latent variable proportionally failed to predict productivity, leaving the facets for governance improvement. The wider frame of reference, comprehensive understanding, and efficient management of production factors are central to augmenting land productivity in paddy production and promoting sustainable agricultural practices.

The limited sample size (285) is one of the limitations of this study, assuming homogeneous socio-economic indices, farm capital, agro-practices, and climatic environments in the study area. Nonetheless, these study results leave significant footprints for local agricultural development, provide policy input for stakeholders, and offer avenues for future researchers. Thus, it’s crucial to minimize policy shocks and implement targeted and tailored approaches with multi-stakeholder engagement. Focusing on agro-specific and sensitive long-term strategies long-term strategies; it’s essential to pursue state and non-state actors’ governing pathways to enhance land productivity and foster comprehensive agro-development.

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