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Does Contract Length Matter? The Impact of Various Contract-Farming Regimes on Land-Improvement Investment and the Efficiency of Contract Farmers in Pakistan

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Abstract: Land-tenure security is integral to local communities' socioeconomic development. It has been a center of debate in academia and for legislators and advocates to implement reforms to enhance efficient and sustainable development in land management. Yet, knowledge gaps remain in how various contract-farming regimes contribute to land-improvement investment and technical efficiency. This study used a data set of 650 farm households collected through a two-stage stratified sampling to investigate the influence of three contract-farming regimes: long-term, medium-term, and short-term contracts, on the land-improvement investment, productivity, and technical efficiency of contract farmers in Punjab, Pakistan. The study used multivariate probit and ordinary least square regression models to examine the posit relationships. The findings highlight that farmers with long-term land contracts have higher per hectare yield, income and profit than those with medium-term and short-term contracts. The results confirm that farmers with medium- and long-term contracts tend to invest more in land-improvement measures, i.e., organic and green manure. Further, the study findings demonstrate that long-term land tenures are more effective when farmers make decisions regarding the on-farm infrastructure, like tube-well installation, tractor ownership, and holding farm logistics. Last, the study results confirm that long-term contracts are more robust regarding technical efficiency. Moreover, the findings support the Marshallian inefficiency hypothesis and extend the literature on contract farming, land-improvement investment, and land use policy, and offer coherent policy actions for stakeholders to improve farmers' productivity, technical efficiency, and income.

Keywords: contract-farming regimes; land-improvement investment; land-use policy; productivity; technical efficiency; organic farming

1. Introduction

The vast prevalence of insecure land-use rights is a primary impediment to developing organic farming in Pakistan. Myriad farmers do not have proper land-use titles and are vulnerable to lease termination, eviction, and seizure at any time [1,2]. Unstable land-tenure arrangements protect farmers from investing in land-improvement measures and farm investment discourages them from switching to sustainable land-management practices [1]. Previous studies have rigorously explored the impact of contract farming on technical efficiency [3–9], the uptake of sustainable farm practices [10], and farmers' income [11–13]. Yet, no research examined the impact of various contract-farming regimes (e.g., one, three, and five-year contracts) on land-improvement investment and efficiency. The country has enormous potential for organic farming [14]; knowledge gaps remain in how various contract-farming regimes contribute to land-improvement investment and technical efficiency. By analyzing the impact of different contract-farming regimes, this study offers valuable insights into the role of contract length in determining farmers' land-improvement investment behavior and the performance of contract farming in the country.

Contract farming can economically contribute to Pakistan's economy [14]. Organic agriculture needs fewer external inputs, like pesticides, chemical fertilizers, and herbicides. Thus, on the input side, it can reduce costs and potentially contribute to farm profit [15]. Organic farming generates numerous employment opportunities; it can help local and remote communities thrive through income generation and employment. It can help instigate a series of organic-related processes that start from the production, processing, marketing, and distribution to the local and far-off markets [16,17], thereby shedding far-reaching impacts on the country's exports and foreign income earned. Progress toward organic farming encourages adopting sustainable land-management practices and improves land productivity. Hence, it translates into improved per hectare yield and higher income [18,19]. Likewise, evidence shows that organic farming promotes rural development strategies by providing the livelihood of rural communities and upscale farmers' livelihood strategies [14,20]. It encourages the development of farming entrepreneurs and clusters, bringing more significant economic benefits through value-addition and improving rural–urban vertical linkages [10,21]. Thus, organic farming has enormous potential to economically contribute to developing economies by increasing productivity, rural development, and supporting a sustainable development agenda [22].

Many researchers noted that land-use rights are crucial to enhancing contract farming [6,23,24]. Organic farming needs longer term contract security to ensure the investment payoff of investors since they need to improve soil health, which takes a couple of years. However, investors or farming entrepreneurs need strong landlord commitment for contract longevity due to the financial risks associated with their investments [8,25]. Given this, secure land arrangements encourage entrepreneurs to invest in farms and apply sustainable land-management techniques and measures to enhance soil health and productivity [26]. In Pakistan, about 38% of the land is owned by absentee landlords, usually considered rent seekers. These absentee landlords operate through third parties without connections to farming and agriculture [27]. Most of them lend their land to small farmers or local communities on short-term (one-year), medium-term (less than three years), and long-term (above five years) contracts. Most short-term contracts are highly insecure and informal, under which farmers cannot decide how to use the land in the short-term [28]. Organic farming demands secure land rights for employing measures like composting, organic manure, green manure, crop rotation, and agroforestry, leading to a sustainable farm ecosystem. Further, secure land-tenure arrangements encourage farmers to invest in farm infrastructure and participate in farm cooperatives to apply innovative technologies to improve productivity and income [29]. Likewise, studies find that land-tenure security is positively related to access to farm credit. Thus, it makes it easier for farmers to provide collateral on loans and offer them the financial ability to invest in organic-promoting practices [30].

Land-tenure security has an enormous role in the development of organic farming. Organic agriculture has environmental implications and ensures the socioeconomic well-being of farmers and local communities [29]. However, the absence of secure land rights disincentivizes farmers to switch to organic farming, which restricts its development [31] and limits opportunities for sustainable development [27]. Secure land tenure can promote sustainable development in agriculture, which contributes to food security, poverty reduction, and climate-change mitigation [31–33].

Given the above debate, the following research questions arise on the role of three operational contract-farming regimes: short term, medium term, and long term. Do characteristics of farmers vary across land-tenure regimes? Do farmers with long-term contracts have higher land-improvement investments? Do various land-tenure regimes have significant variations in farm yield? Do long-term contracts have higher technical efficiency? By answering these questions, the study contributes to the literature on contract farming, land-tenure security, land-improvement investment, and sustainable land-use practices in developing countries.

2. Landscape of Current Land-Use Rights in Pakistan

The following are current land-use arrangements being practiced in Pakistan (the data were obtained online from the Government of Punjab Land Record Website: https://landportal.org/library/resources/guide-land-and-property-rights-pakistan, accessed on 15 June 2023).

1. Ownership: Four ownership categories are recognized at the national level: public, private, common, and cooperative. A system of property laws and customary practices governs land ownership. Ownership, however, could also be impacted by regional or local traditions and practices;
2. Leasing: Short and long-term leases are frequently employed in Pakistani agriculture. Most leases are likely to be informal and based on verbal agreements; however, there are some situations when formal legal contracts are used;
3. Tenancy: Many farmers in Pakistan own a small plot and work as sharecroppers or under unofficial agreements with landowners; they are frequently tenants rather than landowners. Tenants' rights to the property and decision-making authority are mostly restricted and landowners often make crucial choices about the preparation of the land, the choice of crops, and the sale of the products made there;
4. Land redistribution: Instead of being proprietors, many farmers in Pakistan are tenants who frequently cultivate small plots as sharecroppers or under the terms of unofficial agreements with landowners. Tenants frequently have limited rights to control the land and decision-making authority, with landlords having the final say in crop selection, land preparation, and the sale of goods made on the property;
5. Land disputes: In Pakistan, unfortunately, disagreements about property rights, inheritance, and boundary lines sometimes result in land disputes. Farmers, especially those marginalized or without political clout, may struggle to secure land-use rights because of these disagreements.

Pakistan's land-use rights require further reforms to promote agricultural growth and long-term food security. Additionally, there are several reasons why Pakistan's current system of land-use rights is not conducive to the development of organic farming [15]. The leading cause is that most of the fertile land was given to large-scale, commercial farmers that employ cutting-edge technology to grow crops and increase earnings. To get high yields, these farmers frequently use chemical fertilizers, pesticides, and herbicides, which makes it challenging for organic farmers to secure suitable land [34].

In rural locations, landlords typically possess small parcels of land that they lease to tenants for short periods, usually a few years or less. These leases are only temporary, which prevents farmers from making the long-term expenditure required for organic farming [2]. Low levels of external inputs, such as chemical fertilizers, are needed in organic farming. However, it takes time for such procedures to show results, reducing the incentive for landlords to permit their renters to use the property this way. Likewise, poor farmers find it challenging to adopt sustainable agricultural techniques due to a lack of access to capital, training, and extension services [35–37]. Without sufficient technical understanding, farmers may not have the abilities and knowledge to utilize organic farming methods to their fullest potential. Farmers who want to transition to organic farming face another obstacle: a shortage of institutional financing [17]. Most banks and financial organizations are still reluctant to lend money to farmers without some form of collateral. Therefore, farmers with short-term contracts are more insecure are discouraged from embracing innovative agricultural practices that improve soil health, the environment, and local communities' incomes [36,38].

Research Gap

Many studies have explored different dimensions of contract farming. Barret et al. [39] explored the determinants of contract-farming participation and noted that contract participation improves household welfare. Likewise, Fialor et al. [3] studied the effect of contract farming on productivity and illustrated that contract participation improves crop productivity. Further, contract farming enhances the uptake of improved inputs that, in turn, boost productivity and income. Dubert et al. [4] examined the relationship between contract-farming participation and the uptake of sustainable farm practices. The findings indicate that contract farmers use more sustainable farm practices than conventional farmers.

Studies have also explored the interplay between contract farming, ecological change, and reciprocal social transformation [6]. The literature rigorously explored the connection between contract farming and productivity [12,40,41], farmers' income [12,13,42,43], sustainable production [4,5,44,45], loan repayment [36], market integration [7,11,46], and welfare [47,48]. Recent studies have examined the relationship between contract farming and production risk-management strategies [49,50]. No research has examined the impact of various contract-farming regimes (e.g., short, medium, and long-term contracts) on land-improvement investment and efficiency in developing countries. Hence, this study contributes to bridging the literature gap between contract-farming regimes, land-improvement investment, and the efficiency of contract farmers in a developing country context. Through rigorous empirical analysis and comprehensive data collection, this research aims to contribute to the existing literature on contract farming and provide evidence-based recommendations for policymakers and stakeholders in Pakistan's agricultural industry.

3. Materials and Methods

3.1. Sample and Data Collection

The study was conducted in Punjab, Pakistan. Six of nine rice-growing districts in the province (refer to Figure 1) were purposely selected for data collection since these districts account for 80 percent of the total basmati rice production. The data-collection stage took place between January and March 2022, with the target population being the farmers in the "Kalar track", a specialized geographically indicated area renowned for basmati rice production and export. Wheat and vegetable crops are produced in the region, yet rice is the dominant cash crop.

We selected the farmers using an equal-size stratified (two-stage) cluster design. The nine 'kallar track' districts embodied the first cluster, followed by the village (the second stage). We used probability proportion to size (PPS) to allocate villages across the selected districts based on the area under rice production. Thus, it ensures equal sampling proportion in each cluster. Next, systematic PPS was adopted to select the villages within each district using published information on the total number of households in each village. In total, 34 villages from six districts were selected from high-intensity rice districts in Punjab. Following the first stage of selected villages, we randomly selected rice farmers. Based on the prior research and surveys conducted in Punjab (Pakistan Integrated, Household Survey, 1991 (PIHS 1991) of the World Bank (Online available: https://microdata.worldbank.org/index.php/catalog/543, accessed on 15 June 2023)), we set the nonresponse rate at 33% for the second-stage selection. Thus, we adapted and prescribed 30 farmers from each village, of which 20 were finally selected for the final interview. Questionnaires with missing entries were discarded and the final data set of 650 households was obtained for further analysis. We used the following formula to calculate the sample size in this study (see Equation (1)).

$$n = \frac{N}{1 - N(e^2)} \quad (1)$$

where n is the sample size, N represents the population, and e denotes the expected error., There are approximately 100,000 rice growers in the sampled districts. Thus, we used this number as the total population to calculate the sample size by taking the value of the expected error to be 4 percent.

We adopted inclusion criteria for respondents based on three prescribed factors. The criteria were: being an export-oriented rice farmer, engaging in organic rice farming for at least 5 years, and knowing about contract-farming participation. Further, we tested the normality of the dependent variable (see Supplementary Materials S1).

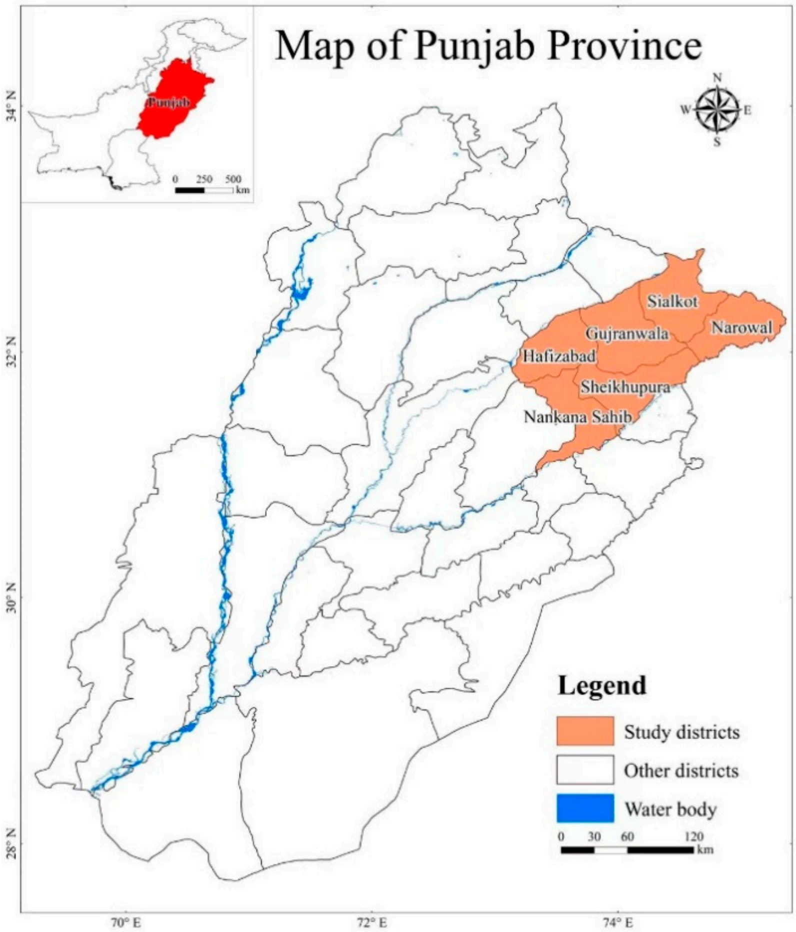

Figure 1. Location of the selected districts.

3.2. Conceptual Framework

This study examines the impact of land-rights arrangements on agricultural production efficiency and investment in land enhancements and yield improvements. The study adapts and builds on the model developed by Akram et al. [28]. The analysis includes a farm-level production function that accounts for fixed factors, such as given below:

$$y = f(x, t, n, ; z) \quad (2)$$

where labor (x), land (t), input(s) (n), and y represent the yield, which is dependent on given factors such as investments in land-enhancing activities. Various variable inputs include green and organic manure, usually from poultry and farm animals, whereas z denotes the farm household characteristics.

Profit maximization is the primary goal of farmers; herein, it is measured by output prices (p), unit labor costs (w), and land costs $r(\theta, \delta)$, which are given as:

$$\pi = \max_{x,t,n}[py(x,t,n;z) - wx - r(\theta,\delta) - cn] \tag{3}$$

This study presents three distinct regimes of land rights, including short-term, medium-term, and long-term contracts, and calculates the cost of land based on these factors, as given below:

$$r(\theta,\delta) = (1-\theta)\bar{r} + \theta\delta py \tag{4}$$

where the shared output ratio (δ), for short-term stands θ = 1, while for the medium term it is θ = 0. Likewise, short-term land cost is p_y, and long-term contracts is r.

Using the following function, profit maximization can be indicated as price function, household endowments, and the three forms of land-use rights given by θ and δ, as given below:

$$\pi = \pi(p,w,c,z,\theta,\delta) \tag{5}$$

By directly applying the profit function, as shown in Equation (3).

$$y = y(p,w,c,z,\theta,\delta) \tag{6}$$

Equation (6) illustrates farmer characteristics and prices that influence the demand for inputs.

3.3. Empirical Specifications

The empirical estimation used is the simple and formal specification form of Equation (6), representing inputs, outputs, and productivity. Initially, the paper compares the farmers' characteristics (e.g., land size, per acre yield, and profit) across the given land-tenure regimes. Next, the study provides empirical estimates on the impact of various contract-farming regimes on land-improvement investment m (green manure G, organic manure M) using a multivariate probit model. This estimation assesses the possible substitutability and complementarity in the investment as an instrument variable. Hence, it helps determine the distinctive effect of land-tenure regimes on per hectare yield, profit, and investment, including farm and farmer-specific characteristics.

Given the land-improvement investment decision, probit specifications were applied to cover the investment for various measures, as follows:

$$\begin{aligned} J_{im} &= B_{im}Q_{im} + \gamma_{im}Z_{im} + \mu_{im} \\ J_{im} &\begin{cases} J_{im}\ if\ J_{im} > 0 \\ 0 \text{ otherwise} \end{cases} \quad m = M,G \end{aligned} \tag{7}$$

Here J_{im} indicates the anticipated profit for farmer i that invests in land improvement m. The term J_{im} refers to measures of observed variables representing land-improvement investment; otherwise, it assumes a value equal to zero. Likewise, the term μ_{im} refers to errors that may have identical distribution. Vector Q_{im} denotes land-tenure regimes and terms θ and δ represent that land is operated under long-term, medium-term, or short-term contracts. Further, the vector Z_{im} represents household and family characteristics like age, education, and farm size.

4. Results and Discussion

4.1. Farm-Level Characteristics

This section compares the various characteristics of farmers based on the three contract-farming regimes, namely long-term (up to five years or more), medium-term (up to three years), and short-term contracts (one year). Table 1 compares the various characteristics of contract farmers, including yield, profit, income, farm size, and other variable inputs used among long-term and short-term contracts. The independent sample *t*-test is used to compute the statistical significance between the means of characteristics of farmers under these two contract regimes.

Table 1. Characteristics of farmers under long-term and short-term contracts.

Variables	Long-Term	Short-Term	T-Value
	Mean	Mean	
Yield (kg/ha)	2381.83	2147.26	4.16 ***
Income per ha	317,200.28	291,675.71	2.29 **
Profit per ha	109,542.71	89,617.29	6.14 ***
Farm size (ha)	7.73	3.81	4.63 ***
Public–private partnership	0.19	0.03	0.38 ***
Farming experience	8.09	4.39	1.75 *
Subsidy financial incentive	0.68	0.57	1.83 *
Organic manure application	0.76	0.53	3.48 ***
Green manure application	0.87	0.83	2.89 ***
Improved seed	5.93	4.27	1.87 *
Hired labor	20.16	15.73	3.57 ***
Family labor	6.39	5.94	1.12
Livestock holding	2.18	3.27	1.26
Household-head age	39.43	43.83	2.18 **
Household-head education	9.17	8.43	2.36 **
Formal credit received	0.53	0.39	1.81 *
Crop rotation	0.87	0.48	1.71 *
Tube-well ownership	0.78	0.48	0.56
Farm advisory	0.59	0.48	0.82

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Among others, farmers with long-term contracts differ from short-term ones in terms of per hectare yield, income per hectare, profit, farm size, and farming experience. Comparatively, it indicates that farmers with long-term contracts have higher mean values. Further, farmers with long-term contracts also have higher green and organic manure values than short-term contracts. Interestingly, public–private partnerships and subsidies or financial incentives exist in long-term contracts. It indicates long-term contracts offer more flexibility and freedom in farming decision-making and entails economic incentives for farmers than short-term contracts. Thus, under long-term agreements, farmers tend to apply more land-improvement measures, like organic manure and green manure, because they can harvest the economic gain of such practices in the longer run.

Table 2 compares the various characteristics of farming under medium-term and short-term contracts. It compares varying factors, including yield, profit, income, farm size, and other variable inputs used in long-term and short-term contracts. *t*-test is used to compute the statistical significance between the means of characteristics of farmers under these two contract regimes.

The *t*-test results indicate that, among others, farmers with medium-term contracts are different from short-term contracts in terms of per hectare yield, income per hectare, and farm size. Regarding the farm size, it inculcates that farmers tried to operate on relatively large farms under medium-term contracts. One of the reasons might be farming experience and realizing the presence of economies of scale. Likewise, mean subsidy or economic incentives values are significantly higher for medium-term contracts. It highlights that farmers feel more secure in medium-term contracts than in short-term ones. Further, farmers with medium-term contracts also have higher values of organic manure than short-term contracts and adopt improved seeds and availed formal credit. Medium-term contracts offer more flexibility to realize economies of scale and expand production and profit.

Table 2. Characteristics of farmers under short-term and long-term land use contracts.

Variables	Medium-Term	Short-Term	T-Value
	Mean	Mean	
Yield (kg/ha)	2196.72	2147.26	1.83 *
Income per ha	299,524.27	291,675.71	1.57 *
Profit per ha	93,748.72	89,617.29	1.08
Farm size (ha)	5.72	3.81	2.35 **
Public–private partnership	0.07	0.03	1.07
Farming experience	4.08	4.39	0.37
Subsidy financial incentive	0.57	0.38	1.87 *
Organic manure application	0.42	0.53	2.27 **
Green manure application	0.87	0.83	1.04
Improved seed	5.31	4.27	2.98 ***
Hired labor	15.32	15.73	1.06
Family labor	5.81	5.94	1.03
Livestock holding	0.73	0.79	0.93
Household-head age	42.17	43.83	1.13
Household-head education	8.24	8.43	1.18
Formal credit received	0.61	0.39	1.78 *
Crop rotation	0.76	0.71	1.24
Tube-well ownership	0.61	0.48	1.87 *
Farm advisory	0.54	0.48	3.40 ***

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3 compares the various characteristics of farmers based on the two contract-farming regimes: long-term (up to five years or more) and medium-term (two years or more) contracts. Table 3 compares the various characteristics of contract farmers, including yield, profit, income, and farm and production-related variable inputs used among long-term and medium-term contracts. A *t*-test is used to compute the statistical significance between the means of characteristics of farmers under these two contract regimes.

Table 3. Characteristics of farmers under long-term and medium-term land-use contracts.

Variables	Long-Term	Medium-Term	T Value
	Mean	Mean	
Yield (kg/ha)	2381.83	2196.72	4.17 ***
Income per ha	317,200.28	299,524.27	1.69 *
Profit per ha	109,542.71	93,748.72	1.98 *
Farm size (ha)	7.73	5.72	1.78 *
Public–private partnership	0.19	0.07	3.94 ***
Farming experience	8.09	4.08	1.95 *
Subsidy financial incentive	0.68	0.57	2.54 **
Organic manure application	0.76	0.42	4.64 ***
Green manure application	0.87	0.83	3.17 ***
Improved seed	5.93	5.31	1.08
Hired labor	20.16	15.32	5.18 ***
Family labor	6.39	5.81	1.21
Livestock holding	2.18	0.73	1.02
Household-head age	39.43	42.17	1.45
Household-head education	9.17	8.24	1.24
Formal credit received	0.53	0.53	0.98
Crop rotation	0.78	0.76	1.24
Tube-well ownership	0.78	0.49	2.67 **
Farm advisory	0.59	0.54	1.87 *

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The results in Table 3 reveal that farmers with long-term contracts differ from medium-term contracts in per hectare yield, income per hectare, profit, farm size, and farming experience. It indicates that farmers with long-term contracts have higher mean values for the above characteristics than medium-term contracts. Further, farmers with long-term contracts also have significantly higher green and organic manure values than short-term contracts. Remarkably, there also exist public–private partnerships and subsidies or financial incentives in long-term contracts, lacking under medium-term contracts. Likewise, farmers under long-term contracts have higher values for improved seed, formal credit, and participation in farm advisory services. Further, farmers with long-term contracts have installed on-farm tube wells and used hired labor. It indicates that under such contracts, farmers tend to invest more in farm infrastructure to seek longer run benefits arising from such investments. It reinforces that long-term contracts entail greater economic security, providing farmers with freedom in decision-making and improving on-farm investment, increasing farm productivity and income. Moreover, it enhances the investment in land-improvement measures, like organic and green manure.

4.2. Econometric Estimations for Land Investment

In this section, we used a multivariate probit model to estimate the effects of various land-tenure regimes on demand for various production-related variable inputs. For this purpose, we study the impact of two land-improvement measures: organic manure and green manure. Further, we used the output delivery function to capture the impact of various land-tenure regimes. Given this, the model assumes a volatile instrument approach and accounts for the contract-farming regimes endogenous to tenure agreements.

4.2.1. Land-Tenure Regimes and Land-Improvement Investment

The first regression phase for land-tenure regimes was based on Equation (4), while the second-phase results represent the instruments used for land-tenure regimes (Table 4). We eliminated one of the three contract-farming regimes—short-term contract—to employ a linear probability model for further estimation. The connection between household characteristics and various land-tenure regimes was calculated. Regarding the key instrument variable, farm location and market connection have a significant and positive relationship with the uptake of long-term land-use contracts. In contrast, the distance to the market has a negative connection with the uptake of both medium and long-term contracts. These instruments identify the collective impact of farm location, market information, and distance on the uptake of various contract regimes. These findings are aligned with prior studies [3,50,51]. Among other factors, farm size, public–private partnership, farm advisory service, agricultural subsidy/economic incentives, farm logistics, livestock holding, farmer-based organizations (FBO) membership, tractor ownership, and organic farming experience are positively associated with the uptake of long-term tenure. These results indicate that land plots near input–output markets are more likely to rent under medium- and long-term contracts. More informed farmers are likely to choose long-term agreements. These findings endorse the prior studies [5,52], advocating that contract farming is a more common phenomenon in areas near big cities and commercial zones.

Interestingly, public–private partnerships and subsidies positively influence the uptake of long-term contracts, which implies that these encourage farmers' prolonged stay in the agriculture business. Moreover, investment in agriculture-allied businesses, like livestock holding, tractor ownership, and farm logistics, tends to induce the prevalence of long-term contracts. These findings support existing evidence on the determinants of contract farming in developing countries [5,6,36,52].

Table 5 reports the consequences of the second phase of investments in land-improvement measures using Equation (5). Considering Marshall's theory of inefficiency [53], the third land-tenure regime, the 'short-term contract' was deleted. Further, we assessed the effect of farmers' characteristics, production-related inputs, land-tenure regimes, and organizational factors on land-improvement investment. According to the results, the correlation coefficient (p) is significant and uncorrelated with land-improvement investment, complementing the suitability of the probit model used herein. We extracted the insignificant residual variables from the first-stage regression—RESO and RESF—for long-term and medium-term contract participation. The results reported herein nullify the presence of inconsistent coefficients and concurrency in variation [54]. Further, Wald test statistics confirm the consistency and robustness of the estimates and model through a residual vector, which is given in Table 5.

Table 4. Estimates of land-use rights using the probit model: marginal effects.

Variables	Medium-Term	Long-Term
	Coefficient	Coefficient
Farm size	0.127 **	0.164 ***
Public–private partnership	0.106	0.217 *
Tube-well ownership	0.085 ***	0.138 ***
Farm advisory	0.083 **	0.156 ***
Subsidy/financial incentive	0.0128	0.148 ***
Distance to market	−0.067 **	−0.125 **
Farm location	0.206	0.178 ***
Market connection	0.173	0.149 ***
Farm logistic	0.097	0.115 ***
Household size	0.037	0.039
Household-head age	0.036	0.064
Household-head education	0.065	0.046
Livestock holding	0.116	0.201 ***
FBO membership	0.126 *	0.174 **
Tractor ownership	0.089 ***	0.075 ***
No. of tillage operations	0.043	0.031
Mechanical harvesting	0.078	0.056
Organic experience	0.043 **	0.106 ***
R^2	0.47.82	
Adjusted R^2	0.46.17	
Breush–Pegan Test (χ^2)	11.53	0.001
Goodness of fit (χ^2)	78.27	0.006

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The results show that the residual of both contract-farming regimes—long term and medium term—the equation is equivalent to zero, thus validating individual *t*-test results. These results support the exogenous theory of land-contract regimes [55]. Table 5 presents the coefficients of land-improvement investment, including long-term and medium-term land contracts. In this estimation, we controlled farm-specific characteristics to improve the robustness of the estimates. The results indicate that long-term contracts enhance the investment in organic and green manure, while medium-term contracts are only related to investment in organic manure. It advocates that long-term contracts induce more significant investment in land-improvement measures. These results align with previous studies [56,57], advocating that improving longer-term contract security would foster land-improvement investment and promote sustainable land-use practices in developing countries.

Farming experience, public–private partnership, FBO membership, and provision of subsidies or financial incentives are related to organic and green manure investment. It inculcates that organizational factors hold significant potential for improving land management and sustainable development in agriculture. Given this, providing targeted subsidies to contract farmers and enhancing public–private partnerships can help foster land-improvement investment vis-à-vis smallholder contract farmers' land-use efficiency, income, and sustainability in developing countries. These findings support the empirical work of [15], complementing that institutional factors promote sustainable land-management practices in smallholder agriculture.

Among the farmer and farm wealth factors, livestock holding, tractor ownership, logistic ownership, and organic farming experience are related to investment in organic and green manure. These findings relate to previous studies [58–60]. This implies that more wealthy, resourceful, and experienced farmers tend to invest more in sustainable land-management measures, which reflect through investment in organic and green manure application.

Table 5. Farmers' investments in land-improving measures: probit model results (marginal effects).

Variables	Organic Manure	Green Manure
Long-term tenure	0.382 ***	0.235 ***
Medium-term tenure	0.162 *	0.025
Farm size	0.261	0.173
Farming experience	0.126 **	0.184 *
Tube-well ownership	0.028	0.073
Public–private partnership	0.195 ***	0.153 ***
Farm advisory	0.108 *	0.083
Market distance	0.075	−0.138
FBO membership	0.237 **	0.114 ***
Subsidy/financial incentive	0.217 **	0.107 *
Household size	0.093	0.117
Training participation	0.037 **	0.112 *
Household-head age	0.136	0.157
Market connection	0.035	0.075
Household-head education	0.183 ***	0.136 ***
Livestock holding	0.205 **	0.183 **
Tractor ownership	0.158 ***	0.276 ***
Farm logistic	0.145 *	0.096
No. of tillage operations	0.362	0.283
Mechanical harvesting	0.082	0.236
Organic experience	0.381 ***	0.425 **
RESF	0.213	0.157
RESO	0.194	0.237
R^2	47.59	
Cross equation correlation (pMG)	0.237 ***	
Joint statistics χ^2	132.13 (0.001)	
Breush–Pegan Test (χ^2)	28.72 (0.007)	
Goodness of fit (χ^2)	75.65 (0.016)	

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4.2.2. Land-Tenure Regimes and Yield

Table 6 reports the determinants of farm yield. It illustrates the impact of contract-farming regimes, farm, farmer-related, and other variables on farm productivity. Using the probit model, we controlled farm and farmer-related variables and used instruments following the previous section. Thus, the instrument covers the medium-term contract as farm distance increases from the market. It implies that if the farm distance from the market is less, the chances of a medium- or short-term contract are less likely. In either situation, the owner is likely to operate the farm or chooses to engage in a longer-term, more stable contract. We used control variables exogenous to contract-farming regimes and inserted the predicted value of first-phase regression results to compute farm productivity. The findings support the previous studies [1,28,59]. The results indicate that long-term and medium-term contracts positively affect farm productivity. It implies that farmers have more per hectare yield under these contracts than short-term contracts. These results support the previous section's results, reinstating that longer-term land contracts are more efficient regarding farmers' efficiency and farm yield. Likewise, the results align with the Marshallian inefficiency hypothesis [53], complementing that short-term contracts are the least effective among the given land-contract regimes. The presence of a public–private partnership and subsidies or economic incentives primarily encourages long-term and medium-term farmers' engagements in agriculture and land-improvement investment. Farm size, farming experience, tube-well ownership, FBO membership, training participation, livestock holding, tractor ownership, and mechanical harvesting significantly and positively affect farm yield per hectare.

Table 6. Determinants of farm yield: OLS estimates.

Variables	Coefficient	T-Value
Long-term tenure	0.137 ***	4.81
Medium-term tenure	0.712 **	2.46
Farm size	0.621 ***	3.39
Farming experience	0.274 *	1.74
Tube-well ownership	0.136 **	2.18
Farm advisory	0.155	0.09
Market distance	0.028	0.78
FBO membership	0.125 ***	3.98
Household size	0.093	0.73
Training participation	0.083 **	2.17
Household-head age	0.092	0.37
Market connection	0.093	1.06
Household-head education	0.027	0.93
Livestock holding	0.671 *	1.78
Tractor ownership	0.127 **	2.45
Farm logistic	0.194	0.87
No. of tillage operations	0.383	0.14
Mechanical harvesting	0.138 ***	4.28
Organic experience	0.183	0.91
Public–private partnership	0.129 **	0.164 ***
FBO membership	0.148 *	1.83
Constant	0.26	4.62
R^2	0.561	
Adjusted R^2	0.546	
p-Value	0.000	
Breush–Pegan Test (χ^2)	14.27	0.035
Goodness of fit (χ^2)	81.93	0.048

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 7 presents the technical efficiency scores and production performance levels of long-term and medium-term contract farmers in Punjab, Pakistan. The results indicate that among the unmatched samples, the efficiency score is 88.2% and 79.5% for long-term and medium-term contracts, respectively. In the matched sample, full sample measures show technical efficiency scores of 87.9% and 75.8% for long-term and medium-term contracts. These indicate that farmers under long-term contracts produce more output (12.1%) than medium-term contracts. Simultaneously, the results illustrate that 12.1% of the potential yield per hectare is lost due to technical inefficiency, which might be due to inefficient inputs. It confirms that improving the state of land-tenure regimes through contract security and long-term stability would help realize higher productivity and economic benefits to the farmers. Likewise, improving the efficiency of crop inputs would help realize the minimization of losses due to technical inefficiency. These results follow prior studies on contract security and technical efficiency [3,5,60], implying that longer-term contract security plays the foremost role in productivity and technical efficiency.

Table 7. Mean and standard deviation technical efficiency in PSM matching estimations.

	Long-Term	Medium-Term	Difference in Means	*t*-Test
	Mean	Mean		
	TE—Probit Model (n = 450)			
Unmatched	0.882	0.795	0.019	3.87 ***
ATT	0.879	0.758	0.027	3.68 ***

Note: *** $p < 0.01$.

Table 8 illustrates the technical efficiency scores and levels of production performance of long-term and short-term contract farmers. In the matched sample, full sample measures show technical efficiency scores of 86.2% and 74.6% for long-term and short-term contracts. These indicate that farmers under long-term contracts produce more output (11.8%) than short-term contracts. Simultaneously, the results illustrate that 13.8% of the potential yield per hectare is lost due to technical inefficiency. It confirms that improving the state of land-tenure regimes through contract security and long-term stability and improving the input use efficiency would help realize higher productivity and economic benefits to the farmers. Further, the two-sample *t*-test confirms that long-term, medium-term, and long-term and short-term contract regimes statistically differ regarding technical efficiency. It reinstates the findings that a longer term contract is more secure and improves productivity, technical efficiency, and investment in land-improvement measures.

Table 8. Mean and standard deviation of technical efficiency in PSM matching estimations.

	Long-Term	Short-Term	Difference in Means	*t*-Test
	Mean	Mean		
	TE—Probit Model (n = 400)			
Unmatched	0.873	0.755	0.031	4.13 ***
ATT	0.862	0.746	0.022	3.77 ***

Note: *** $p < 0.01$.

5. Conclusions, Policy Implications, and Way Forward

Land-tenure security plays an integral role in the socioeconomic development of local communities. It has been a center of debate in academia and for legislators and advocates to implement reforms to enhance efficiency and sustainable development in land management. Likewise, in the face of mounting challenges of climate change and productivity, it has been crucial to validate the policy reforms on the role of land-tenure length and current land-tenure regimes in developing countries. This study investigates the influence of three contract-farming regimes, long-term, medium-term, and short-term contracts, on the land-improvement investment, productivity, and technical efficiency of contract farmers in Punjab, Pakistan. The study used a data set of 650 farm households gathered through face-to-face interviews. The study provides interesting insights into the role given contract-farming regimes and offers practical policy suggestions for stakeholders.

The findings of the study are fourfold. First, the results suggest that farmers with long-term land contracts have higher per hectare yield, income, and profit than those with medium-term and short-term contracts. Likewise, findings demonstrate that farmers have higher PPPs and subsidies or financial incentives under longer-term contracts. Second, the results confirm that farmers with medium- and long-term contracts tend to invest more in land-improvement measures, i.e., organic and green manure. Further, under these contracts, farmers have more yield and higher demand for crop- and land-improvement measures, i.e., hired labor and improved seeds. The findings support the Marshallian inefficiency hypothesis and reinstate that short-term land tenure is more inefficient than a long-term contract. Third, the study findings demonstrate that long-term land tenures are more effective when farmers make decisions regarding the investment in land-improvement measures (e.g., organic and green manure application) and on-farm infrastructure, like installation of a tube well, tractor ownership, and holding a farm logistic. Last, the study results confirm that long-term contracts are more robust regarding technical efficiency. Hence, the empirical evidence supports the notion that farmers with long-term and secure land-use rights tend to invest more in land-improvement measures. Likewise, it reinstates that long-term contracts are more fruitful regarding yield, productivity, and economic efficiency. Further, the findings clarify that long-term lease agreements offer higher institutional incentives to farmers and encourage the adoption of the latest technology to boost productivity and farm income.

Based on the study findings, the following policy actions are suggested to improve land-use rights, land-improvement investments, and sustainable development in developing countries. First, there is a need to enhance land-use rights. Land-use reform could be integral to turning the current land-use regimes into robust lease agreements. This could be accomplished by clearly defining the land-use rights under various contract and lease agreements and protecting and enforcing such laws. This would help promote longer term land-improvement investment and sustainable development. Second, complex regulations need to be simplified and streamlined. For that purpose, there is a need to revisit current bureaucratic complexities, which are the foremost barriers to land-improvement investment. A robust and efficient set of land regulations would help navigate investors toward land-improvement investment by reducing the costs and related complexities. Third, there is a dire need to improve land-tenure security, particularly for medium and short-term contract farmers. Short contracts are extremely insecure and hinder land investment in developing countries. Since investment needs a more extended payoff period, the government should reform land lease arrangements that protect the rights of land investors for the broader interests of the local communities and society. Four, a public–private partnership (PPP) has enormous potential to harness a significant investment in land-improvement measures. The government can encourage investors by easing regulatory and legal frameworks and financial incentives, like tax relief, to promote sustainable land management and the broader interests of society. Moreover, promoting sustainable land-use practices by incentivizing through subsidizing green-promoting farm implements would help realize minimal risks to the environment and local communities. In sum, implementing these actions can help foster land-improvement investment, promote economic activities for local communities, and support efforts for sustainable development in developing countries.

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