Measuring the Performance of Communal Irrigation Systems in Bohol, Philippines

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Abstract

This study aims to measure the performance of communal irrigation systems (CIS), using cropping intensity and farm yield as indicators. In particular, the study focused on the importance of collective action and how it affects the performance of CIS as a form of irrigation system in the Philippines. The unit of analysis used is the irrigators' association (IA) that manages a CIS across the province of Bohol, Philippines. Analysis of variance was used to determine whether there are significant differences in the performance indicators among the three IA classifications. Likewise, Tobit analysis and ordinary least squares estimation method were used to determine the significant factors that influence cropping intensity and farm yield as performance indicators. The results showed that excellent-rated associations have significantly higher cropping intensity and farm yield than the satisfactory- and fair-rated associations. With respect to the determinants of the performance indicators, labor contribution as a proxy of collective action, has a positive and significant influence on the performance of the irrigation system. Likewise, farm size and farm location have significant and positive effects on cropping intensity and farm yield. However, firmed-up service area and age of the association is statistically significant in farm yield only. To improve the performance of CISs, the study recommends that both monetary and labor contributions must be promoted among farmer-members of each IA.

Keywords: cropping intensity, farm yield, communal irrigation system, collective action

JEL Classification: D71, Q15

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Introduction

Agriculture has played an essential part in economic development throughout history. Its expansion is necessary to advance other sectors, such as services and manufacturing, by providing excess labor and other inputs needed in those sectors (Johnston and Mellor 1961; Timmer 1988; Gollin, Parente, and Richardson 2014). However, the necessary inputs must be present for agriculture to play its role and bring the supposed benefits it has to offer to the other economic sectors. These inputs come in a variety of forms, ranging from support services like credit access that the government or the private sector can invest in and establish physical infrastructures (e.g., irrigation systems) and extension services in agriculture (Mosher 1981; McArthur and McCord 2017).

Irrigation is considered as the most important factor in agricultural production. Thus, providing the farming sector with sufficient irrigation systems to increase output growth is much more significant than when this input is constrained or inadequately provided (Haq and Shafique 2009). In the Philippines, the irrigation programs implemented by the National Irrigation Administration (NIA) are underperforming (David and Inocencio 2014) due to the large cuts in government budget for agricultural investments. According to the Philippine Institute for Development Studies (Inocencio, David, and Briones 2013), some of the significant factors that explain why the irrigation systems in the country underperform are: (1) water requirements in the field are underestimated, (2) water losses are incurred due to seepage, (3) water distribution facilities are inappropriate and inefficient, and (4) other external factors that affect the quantity and quality of irrigation water supply.

NIA is a government-owned and -controlled corporation that manages irrigation systems for agriculture. Currently, irrigation service fees are free by virtue of Republic Act (RA) No. 10969 or the Free Irrigation Service Act of 2018. This law primarily aims to promote agricultural expansion and to increase farmers' income by providing farmers with free irrigation service to lower their production costs. The law covers those farmers with landholdings of not more than 8 ha, either in national irrigation systems (NIS) or communal irrigation systems (CIS). Moreover, the law prescribes that all unpaid dues of farmers or the irrigators' associations (IAs) will "be condoned and written off" from the accounts of NIA (RA 10969 2018).

Before this law was enacted, there had been issues on how irrigation water was being used since the previous water pricing was below recovery cost. The inefficient collection of fees from farmers further aggravated the situation since these fees were needed to operate and maintain the irrigation systems (David 2000). At present, there are three categories of irrigation systems:

1. NIS, which are large and medium irrigation systems covering more than 1,000 ha and constructed by NIA;
2. CIS, which are small-scale irrigation systems that cover less than 1,000 ha; and
3. Private irrigation systems operated by private firms (NIA 2017).

In central Visayas, irrigation development is around 91 percent of the overall projected irrigable area, which is estimated to be at 53,647 ha based on the 2017 inventory report of NIA. This means that NIA has already developed irrigation systems for 91 percent (around 49,285 ha) of the region's irrigable area. In some areas where NIA passes on the irrigation projects to IAs for operation and maintenance, cost recovery becomes problematic. This is mainly because some farmers do not realize the responsibilities that go along with the benefits of irrigation projects, in which they have to pay a certain amount for every instance of water consumption (Easter and Liu 2005).

The main objective of this study is to measure the performance of CIS in Bohol, Philippines. CIS are small-scale irrigation systems that farmer-beneficiaries manage through their IAs. NIA usually builds this type of irrigation infrastructure, and later on turns it over to the IAs through the irrigation management transfer (IMT) program, in order for the IAs to operate and maintain the infrastructure (NIA 2017). More specifically, this study seeks to address the following objectives:

1. Describe the attributes of the IAs managing the CIS in Bohol, Philippines.
2. Analyze the effects of monetary and labor contributions on the performance of these CISs.
3. Determine the significant sociodemographic characteristics that influence the performance of this type of irrigation system.

Review of Literature

Issues and Problems in Irrigation Management

David and Inocencio (2014) evaluated the performance of the NISs in the Philippines using the following indicators: cropping intensity, irrigation service fee collection rate, and physical infrastructure design of irrigation systems. The study showed that all indicators had downward trends ever since NIA was created. Accordingly, the authors explained that the reason the NISs were underperforming was the delayed public investments in irrigation systems and because "the best options for irrigation development have been developed earlier" (David and Inocencio 2014, 8). In relation to this, The Philippine Star (7 June 2016) reported that Philippine Secretary of Agriculture Emmanuel Piñol had suggested that recognizing the farmers as partners through promoting CIS would help to address the underperformance of irrigation systems in the country.

Another reason why irrigation problems exist is because the operations and management of the irrigation systems are transferred to the local water users' associations. The IMT program primarily aims to empower farmers and to engage them in the sustainable use of irrigation water. However, data from the ground suggest otherwise. Bedore (2011) explored the various practices of the water associations with respect to operating and maintaining irrigation systems and found that IAs lack financial resources to operate and maintain the irrigation systems. Likewise, there are no defined water rights and services that allow farmers to maximize the use of the irrigation systems passed on to them (Bedore 2011). On the other hand, Delos Reyes (2017) cited the misconception that providing irrigation is a social benefit rather than an economic service; as such, NISs in the Philippines have failed to be modernized.

Meanwhile, Bumbudsanpharoke and Prajamwong (2015) assessed the performance of irrigation systems coming from one of the largest irrigation schemes in Thailand. The authors used four sets of indicators, namely, agricultural, economic, water service, and physical performance. In terms of agricultural performance, their results showed that crop yields from the farms serviced by the irrigation facilities were higher than the target value, albeit there were some few systems that fell short of the target. With respect to economic performance, the budget for operation and maintenance of these irrigation systems was lower than what was required to cover the annual costs of system maintenance. In terms of water service performance, the efficiency of water infrastructure in the area was enough to "provide a reliable water service to users." Lastly, the physical performance of the irrigation facilities were subpar, which was aggravated by the increasing risks of water shortage in the area.

The previous findings are also supported by a study conducted in China. Zhou (2013) argued that decentralizing water governance to local users does not necessarily improve irrigation management as previously believed. The study found that local users do not automatically participate in collective action as soon as the government transfers irrigation management to them. The author further argued that such decentralization policies ignore the various physical conditions and local institutions that could change the incentive structure that is affecting the local water users' behaviors. According to Ostrom (2004, 4), "it is also important that policymakers [do] not presume that they are the only relevant actors in efforts to solve collective action problems. They have partners if they are willing to recognize them" (Ostrom 2004).

Collective Action and Irrigation Management

There are existing studies that determine the factors of collective action in addressing irrigation problems. Tsusaka et al. (2015) tested how collective action among irrigated and rainfed farmers in Bohol influenced the spillover of social behavior among their respective neighbors. The results of the study found that only in irrigated areas do farmers' altruistic behavior and contributory behavior spillover to their neighbors. By holding the behavioral traits between irrigated farmers and rainfed farmers constant, their results indicated that the collective action required in irrigated water management would likely induce the emergence of social norms; farmers would decide on their social behavior similar to that of their neighbors. Their analysis also showed that farmers' positive response to their own free-riding behavior in the irrigated areas may also be regarded as the emergence of social norms through which individuals' free-riding acts are voluntarily corrected (Tsusaka et al. 2015).

On the other hand, Fujiie, Hayami, and Kikuchi (2005) investigated the significant preconditions to effectively manage the irrigation systems in the Philippines.The study was conducted in Region 4 with 46 IAs. Farmers' participation in irrigation management was measured in four phases, namely, cleaning of canals and laterals, coordination in rice cropping schedule, practice of water rotation, and organized monitoring of cropping schedule and/or water rotation. Results showed that NIA's IMT program failed in more instances because the management of irrigation systems to the IAs was transferred hastily. Most of these IAs were ill-prepared to organize themselves into a collective action, which is necessary to have a successful turnover of the irrigation systems (Fujiie, Harami, and Kikuchi 2005).

Meanwhile, Dhakal, Davidson, and Farquhason (2018) identified the factors affecting farmers' cooperative behaviors so that irrigation resources in Nepal would be managed successfully. An irrigation system was considered successfully managed if it was well-maintained and there was high level of trust among its users. Using ordinal regression analysis, the study found that having a canal lining was a significant factor in determining the efficiency level of maintaining the irrigation system and the level of trust among the appropriators. Aside from this, the variation of income among users and the level of economic efficiency were also significant determinants. The study concluded that effective institutions are necessary to ensure that the physical infrastructure of irrigation systems work in good condition and to ensure that irrigation water is efficiently distributed among the appropriators.

Lastly, Muchara et al. (2014) used different analytical tools to determine the factors affecting farmers' participation in collective activities in one of the irrigation systems in South Africa. Using Tobit and ordered Probit regression models, the results indicated that the farmers' low literacy level negatively affects the collective action among farming households in the KwaZulu-Natal province, South Africa. Meanwhile, the degree of water scarcity is also a significant factor that affects farmers' participation in collective action. The study also showed that members who financially contributed to their associations are more likely to participate at higher levels of collective action. In measuring collective action, the study used principal component factor analysis to determine the intensity level of farmers' participation in collective action. The determinants of farmers' participation were location of plot, income contribution on maintenance, income from irrigation farming, total household land ownership, frequency of attending meetings, training in irrigation management, involvement in water-related conflict, farmer perception of committee effectiveness, amount of labor per household, and years of formal education. The authors noted that analyzing the factors that affect farmers' participation in collective action is necessary for developing policies related to the management of smallholder irrigation systems.

Methods of Data Analysis

This study was conducted in the province of Bohol in Central Visayas, Philippines. According to NIA Region 7, Bohol has 156 CIS with an estimated 14,877 farmer-members. Each of these CISs is managed by an IA, which was used as the unit of analysis in this study. These IAs were classified into excellent, satisfactory, and fair based on the functionality survey of NIA in 2017. The data collection method used was a combination of household survey of 348 farmers, who represented the 63 IAs, and key informant interviews with IA leaders. Two cropping seasons were considered, namely, July–October 2017 (wet season) and January–April 2018 (dry season).

Description of Variables

The dependent variables used were cropping intensity and farm yield. Cropping intensity was measured as the ratio of rice farms (ha) that had been irrigated during the wet and dry cropping seasons to the total irrigation service area per IA. On the other hand, farm yield referred to the average yield of unmilled rice in sacks per hectare of land. These two variables were used as performance indicators mainly because these were the only indicators that NIA 7 regularly monitored and could be readily validated in the field through interviews with IA leaders.

The independent variables used to explain the performance indicators of CIS were: *monetary and labor contributions, firmed-up service area, age of the association, farm size and location,* and *group size*.

Monetary and labor contributions were used as proxies for collective action. *Monetary contribution* was measured as the percentage of farmer-members who had contributed money to their respective IAs in the last two cropping seasons. These variables are expected to have positive effects on both cropping intensity and farm yield. If all farmer-members would contribute monetary payments and volunteer their labor regularly, then the IAs would have their own funds and labor for the operation and maintenance of their own irrigation facilities. A well-maintained irrigation facility is expected to perform better than those facilities that are not, ceteris paribus. Likewise, *firmed-up service area,* another independent variable, referred to the number of hectares that had been irrigated during dry and wet seasons. The expected sign for this variable is negative since an increase in the service area would reduce cropping intensity, ceteris paribus. *Age of the association* was expressed as the number of years that the IA has been operating. The expected sign for this variable is positive since older IAs tend to be more successful in terms of collective action than the newer IAs, holding other factors constant. *Farm size,* meanwhile, referred to the average farm size of all farmer-members per IA. Its expected sign is negative, since farmers who have large landholdings have more exit options; hence, it would be difficult for an IA to impose the rules required to operate and maintain the irrigation system. *Farm location* was measured as the percentage of farmer-members whose farm lots are located within the 1-km radius of the irrigation facility. The expected sign is positive, since members whose farms are located near the irrigation facility would most likely benefit from it. This means that they would continue to contribute to collective activities within their IAs, all other things being equal. Lastly, *group size* referred to the actual number of farmer-members per IA. The expected sign is either positive or negative. This variable can have a positive sign because having more members would likely increase the rate of contribution to collective activities, provided that the group is homogeneous. However, larger IAs that tend to be more heterogeneous would likely experience lower participation of their members in collective action.

Analytical Tools

Descriptive statistics were used in this paper to show the sociodemographic characteristics of CIS, whereas, analysis of variance (ANOVA) was used to determine whether there were significant differences among the classifications of IAs. Once the significant differences had been established, a post hoc test was conducted to determine which groups significantly differed from each other. Accordingly, the one-way ANOVA was robust enough to tolerate any violation to the normality assumption on the condition that the sample size per group is sufficiently large. However, Welch's ANOVA was used should the homogeneity of variance be violated. Welch's ANOVA works in the same way as one-way ANOVA, albeit it is designed to tolerate heterogeneous variance (Liu 2015).

Meanwhile, Tobit and ordinary least squares (OLS) estimation methods were used to determine the significant factors affecting the performance indicators of CIS. Tobit estimation was the most appropriate estimation method for cropping intensity since it is considered to be a censored variable, i.e., it has lower bound (i.e., 0%) and an upper bound (i.e., 100%). Wooldridge (2013) explained that using a linear model to estimate a censored dependent variable can make a good approximation; however, using this method may give negative fitted values, which may lead to negative predictions of the dependent variable. To avoid this, researchers often use Tobit regression analysis to deal with left-censored (i.e., clustered at the minimum) or right-censored (i.e., clustered at the maximum) dependent variable. Accordingly, the standard Tobit model is given by the following equation:

$$\begin{aligned} y_i^* &= x_i\beta_k + \varepsilon_i \\ y_i &= y_i^* \quad \text{if } y_i > 0 \\ y_i &= 0 \quad \text{if } y_i \leq 0 \end{aligned} \tag{1}$$

where:

y_i^* = latent dependent variable;
y_i = observed dependent variable;
x_i = vector of independent variables;
β_k = vector of Tobit coefficients;
ε_i = error term, which is assumed to be normally distributed; and
i = unit of analysis.

The latent dependent variable would be equal to the observed dependent variable if the latter is greater than zero. On the other hand, the latent dependent variable would be equal to zero if the value of the observed dependent variable is equal to or less than zero.

The standard Tobit model presented above can be estimated using maximum likelihood. Accordingly, the maximum likelihood estimation (MLE) of the censored regression model depends on the strong assumption that the error term is normally distributed (Schmidheiny 2007). Meanwhile, interpreting the estimated coefficients of the Tobit regression relies on which type of dependent variable is relevant in addressing the objectives of the study. In most cases, two types of marginal effects are derived depending on whether the interpretation is intended for the latent dependent variable or the observed one. The following equations are presented to derive the marginal effects for both:

$$\frac{\partial E(y_i^* \mid x_i)}{\partial x_{ik}} = \beta_k \tag{2}$$

$$\frac{\partial E(y_i \mid x_i)}{\partial x_{ik}} = \beta_k \Phi\left(\frac{x_i'\beta}{\sigma}\right) \tag{3}$$

Equation (2) shows that the estimated coefficient β_k can be interpreted directly as the marginal effect of the independent variable on the uncensored latent variable y_i^*. Equation (3), on the other hand, shows that when the effect of the independent variable is on the observed value (i.e., y_i), which is the primary objective, then the marginal effect represented by $\beta_k\Phi\left(\frac{x_i'\beta}{\sigma}\right)$ must be derived. Accordingly, these marginal effects depend on the individual characteristics of the independent variables; they can be reported only for specified types or as average effects in the sample population (Schmidheiny 2007). In this study, the estimated coefficients in Equation (2) were interpreted as the linear effects on the uncensored latent variable, and not on the observed outcome or the underlying linear relationship in the sample population (IDRE 2018). This paper is interested in determining the predicted outcome of collective action within an IA, while considering the effects of the independent variables.

For cropping intensity, the following Tobit model was estimated using maximum likelihood:

$$Crop\_Int_i = \beta_0 + \beta_1 Money\_Con_i + \beta_2 Labor\_Con_i + \beta_3 FUSA_i + \beta_4 Age_i + \beta_5 Farm\_Size_i + \beta_6 Farm\_Loc_i + \beta_7 Group\_Size_i + \mu_i \quad (4)$$

On the other hand, the determinants of farm yield were estimated using the OLS method. This estimation method is a generalized linear modeling technique that may be used to model a single response variable, which has been recorded on, at least, an interval scale (Hutcheson 2011). Olagunju and Ajiboye (2010, 2524) argued that "the standard Tobit model assumes, among other things, that the dependent variable is censored at zero. If no censoring has occurred or if censoring has occurred but not at zero, then the standard Tobit specification is inappropriate." Likewise, Foster and Kalenkoski (2013) also showed how using the OLS method can still be justified even when the dependent variable is both left- and right-censored. In particular, their results showed that Tobit estimates were more sensitive than OLS estimates to the prevalence of zeros in the data.

In this study, farm yield was measured in terms of the number of unmilled sacks of rice per hectare. This dependent variable was not bounded above (i.e., no upper limit) and did not exhibit clustering of any value at its minimum value (i.e., at 0); this then justifies using the OLS estimation method. The general form of a linear regression model with multiple predictors is given as follows:

$$Y_i = \alpha + \beta_2 X_{2i} + \beta_3 X_{3i} + \ldots + \beta_k X_{ki} + \mu_i \; i = 1, 2, \ldots, n \quad (5)$$

where:

- Y_i = latent dependent variable;
- α = observed dependent variable;
- β_k = vector of independent variables;
- X_{ki} = vector of Tobit coefficients;
- μ_i = error term, which is assumed to be normally distributed; and
- i = unit of analysis.

The estimated coefficients in Equation (5) are interpreted as the linear effects of the independent variables on the dependent variable. In this study, the following regression model for farm yield is presented as:

$$Farm\_Yield_i = \beta_0 + \beta_1 Money\_Con_i + \beta_2 Labor\_Con_i + \beta_3 FUSA_i + \beta_5 + \beta_4 Age_i + Farm\_Size_i + \beta_6 Farm\_Loc_i + \beta_7 Group\_Size_i + \mu_i \quad (6)$$

Although the two performance indicators were estimated using different methods, the same set of explanatory variables was used to explain the variations in the dependent variables. These predictors are described as follows:

- $Money\_Con_i$ = monetary contribution (percent)
- $Labor\_Con_i$ = labor contribution (percent)
- $FUSA_i$ = firmed-up service area (ha)
- Age_i = age of the association, (no. of years)
- $Farm\_Size_i$ = farm size (ha)
- $Farm\_Loc_i$ = location of farm lots (percent)
- $Group\_Size_i$ = group size, (no. of members)
- μ_i = error term
- i = irrigator's association (IA)

The estimated coefficients of the Tobit model could be interpreted in the same way as that of the OLS estimation, in which the estimated coefficient describes the change in the dependent variable that is associated with a unit change in the independent variable (Hutcheson 2011). However, unlike the straightforward interpretation of OLS, the linear effects of the estimated coefficients in Tobit are on the uncensored latent variable and not on the observed outcome of the dependent variable (IDRE 2018).

Both regression models were subjected to post-estimation tests. For the multicollinearity problem, the variance inflation factor (VIF) was used to check whether the independent variables were linearly dependent of each other. On the other hand, the Breusch-Pagan/

Cook-Weisberg test was used as for OLS regression models that have heteroscedasticity problems, while a test of Tobit specification (i.e., bctobit) was used to check for heteroscedasticity of the Tobit regression model. Robust standard errors were then used to correct for heteroscedasticity problem. Lastly, a specification link test for single-equation model (i.e., link test) was used to check for model specification in both regression models.

Results and Discussion

Sociodemographic Attributes of the Irrigators' Associations

Table 1 presents the distribution of the 63 IAs according to their sociodemographic characteristics, namely, monetary and labor contributions, size of the firmed-up service area, age of the association, farm size, farm location, and group size.

The table shows that the average percentage of farmer-members who contribute monetarily to

Table 1. Distribution by sociodemographic attributes and IA classification of 63 IAs, Bohol, Philippines, 2018

Sociodemographic Attributes	Fair	Satisfactory	Excellent	All
Monetary contribution (%)				
Mean	9.64	37.01	53.25	33.37
SD	18.70	32.29	39.18	35.72
Minimum	0.00	0.00	0.00	0.00
Maximum	62.50	100.00	100.00	100.00
Labor contribution (%)				
Mean	40.24	38.37	90.12	56.24
SD	32.92	30.25	14.11	35.95
Minimum	0.00	0.00	60.00	0.00
Maximum	80.00	87.50	100.00	100.00
Firmed-up service area (ha)				
Mean	69.00	50.52	33.48	51.00
SD	29.77	18.76	18.68	26.94
Minimum	40.00	25.00	6.00	6.00
Maximum	150.00	100.00	75.00	150.00
Age of association (no. of years)				
Mean	13.96	12.84	12.60	13.13
SD	9.76	9.92	7.02	8.87
Minimum	3.40	1.50	3.00	1.50
Maximum	39.00	40.00	28.00	40.00
Farm size (ha)				
Mean	0.65	0.59	0.41	0.55
SD	0.19	0.21	0.10	0.20
Minimum	0.20	0.20	0.20	0.20
Maximum	0.90	1.10	0.60	1.10
Farm location (%)				
Mean	47.16	41.03	73.76	53.99
SD	18.65	18.69	13.63	22.14
Minimum	20.00	12.50	37.5	12.5
Maximum	75.00	80.00	90.00	90.00
Group size (no. of members)				
Mean	73.67	66.19	61.76	67.21
SD	56.58	58.11	34.72	50.35
Minimum	26.00	13.00	21.00	13.00
Maximum	256.00	294.00	158.00	294.00

Note: SD = standard deviation

each IA is around 33 percent. In terms of labor contribution, the average percentage of farmer-members who volunteer their labor to their IAs is around 56 percent. Moreover, an IA has an average firmed-up service area of 51 ha and its average age is 13 years. Similarly, the average farm size of an IA is 0.55 ha. Lastly, around 54 percent of the farmers' lots are located within the 1-km radius of the irrigation facility, and the group size of each IA averages 67 farmer-members.

Monetary contribution form of collective action

Based on the data presented in Table 1, excellent-rated IAs have the highest average number of farmer-members who contribute money to their respective IAs (M = 53.25%, SD = 39.18), whereas, fair-rated IAs have the lowest (M = 9.64%, SD = 18.70). The result of Welch's ANOVA revealed that there are statistically significant differences among the classifications of IAs, $F(2, 36.12) = 13.74$, $p<0.01$. Games-Howell (GH) post hoc test was also performed to determine which among the groups are statistically significant from each other. Accordingly, results show that satisfactory- and fair-rated IAs and excellent- and fair-rated IAs are statistically different from each other with GH = 3.36, $p<0.01$ and GH = 4.62, $p<0.01$, respectively (Table 2). This implies that both excellent- and satisfactory-rated IAs have higher monetary contributions than fair-rated IAs.

Table 2. Analysis of variance and post hoc test results, sociodemographic attributes, and IA classification

Sociodemographic Attribute	ANOVA		IA Classification Comparison	Post Hoc Test	
	F-ratio	p-value		t-ratio	p-value
Monetary contribution	13.37***	0.000	Satisfactory vs. fair	3.36***	0.006
			Excellent vs. fair	4.62***	0.000
			Excellent vs. satisfactory	1.48^{ns}	0.310
Labor contribution	38.40***	0.000	Satisfactory vs. fair	−0.19^{ns}	0.997
			Excellent vs. fair	6.38***	0.000
			Excellent vs. satisfactory	7.10***	0.000
Firmed-up service area	11.39***	0.000	Satisfactory vs. fair	3.36***	0.006
			Excellent vs. fair	4.62***	0.000
			Excellent vs. satisfactory	1.48^{ns}	0.310
Age of the association	0.14^{ns}	0.873	Satisfactory vs. fair	−0.37^{ns}	0.927
			Excellent vs. fair	−0.52^{ns}	0.863
			Excellent vs. satisfactory	−0.09^{ns}	0.996
Farm size	15.71***	0.000	Satisfactory vs. fair	−0.93^{ns}	0.622
			Excellent vs. fair	−5.06***	0.000
			Excellent vs. satisfactory	−3.57***	0.003
Farm location	21.64***	0.000	Satisfactory vs. fair	−1.16^{ns}	0.483
			Excellent vs. fair	5.03***	0.000
			Excellent vs. satisfactory	6.19***	0.000
Group size	0.335^{ns}	0.717	Satisfactory vs. fair	−0.42^{ns}	0.907
			Excellent vs. fair	−0.82^{ns}	0.692
			Excellent vs. satisfactory	−0.30^{ns}	0.952

Notes:
***, **, *, significant at 1 percent, 5 percent, and 10 percent probability levels, respectively;ns = not significant
ANOVA = analysis of variance
IA = irrigators' association

Meanwhile, some IAs do not have any member who contributes money to the association, as indicated by the minimum contribution of zero (Table 1). Currently, the national government is implementing the Free Irrigation Act of 2018, which gives free irrigation services to farmers who own less than 8 ha of farm lot. The same law provides that "CIS shall continue to be operated and maintained by IAs. In lieu of the irrigation service fees that are no longer billed from exempted farmers, the national government shall provide the equivalent funds for the operation and maintenance of CIS" (Sec. 6, RA 10969). However, despite this provision, the law does not prohibit members' voluntary payment to their respective IAs for the operation and maintenance of the irrigation facility. Based on an interview with one of the key informants of the study, NIA even encourages IAs to collect monetary payments from their members, so that they can have their own funds to operate and maintain their irrigation facilities without depending too much on the government. This may be the reason why some IAs still collect money from their members regardless of their performance classification. For example, about 10 percent of the members of the fair-rated IAs contribute financially, whereas, around 37 percent of the members of the satisfactory-rated IAs contribute money to their association (see Table 1). In view of the implementation of RA 10969, it can be deduced from the results that farmer-members' monetary contribution might be voluntary, as opposed to being required by their respective IAs.

Labor contribution form of collective action

The percentage of farmers that contribute labor to their respective IAs is higher than that of those contributing money across the three groups of IAs (Table 1). This collective action indicator has the same trend as the monetary contribution, in which excellent-rated IAs have the highest average percentage of farmer-members who provide voluntary labor contribution for the operation and maintenance of their respective IAs (M = 90.12%, SD = 14.11). Although the other two groups have less labor contribution than the excellent-rated IAs, they still have relatively high percentage of farmers who contribute labor as compared to the percentage of farmers who contribute money. In the case of the fair-rated IAs, about 40 percent of the farmer-members volunteer to work for the operation and maintenance of their CIS in the past two cropping seasons, whereas, satisfactory-rated IAs have 38 percent.

Table 2 shows the result of the analysis of variance, which yielded a significant result, $F(2, 34.39) = 38.40, p<0.01$. Similarly, the post hoc test shows that there are significant differences between excellent and fair IAs ($GH = 6.38, p<0.01$) and between excellent and satisfactory IAs ($GH = 7.10, p<0.01$). Thus, collective action in the form of labor contribution is significantly higher and more apparent among excellent IAs compared to the satisfactory or fair IAs. One possible explanation for the higher labor contribution among excellent IAs is the presence of enabling institutions in these IAs that engages its members to participate in collective activities, such as cleaning up and rehabilitating the irrigation canals. These enabling institutions take in the form of a well-functioning charter within an autonomous IAs, whose members are religious, generally trusting, and who frequently socialize.

Firmed-up service area

Firmed-up service area refers to the irrigable area that can be irrigated by the existing type of irrigation system. Based on the results in Table 1, excellent-rated IAs have the smallest average firmed-up service area (M = 33.48, SD = 18.68), whereas, fair-rated IAs have the largest (M = 69.00, SD = 29.77). Meanwhile, the satisfactory-rated IAs have 50.52 ha (SD = 18.76).

IA classifications significantly differ from each other with respect to firmed-up service area at $F(2, 38.77) = 11.39, p<0.01$. Accordingly, post hoc test results reveal that there are significant differences between excellent and fair IAs ($GH = 4.62, p<0.01$), and between satisfactory and fair IAs ($GH = 3.36, p<0.01$). These results imply that large firmed-up service areas are mostly found among fair-rated IAs possibly because smaller service areas are relatively easier to manage and maintain compared to larger ones.

Age of the association

The age of an IA was determined in this study based on the year that it had been created either by the farmers or NIA. Excellent-rated associations have the shortest average number of years of operation (M = 12.60, SD = 7.02), whereas, fair-rated IAs have the longest (M = 13.96, SD = 9.76) (see Table 1). Across all types of IAs, the maximum age of an IA is 40 years, whereas, the minimum is 1.5 years. Although the average ages of all IAs are quite similar, most of the newly organized IAs are rated as excellent, while those that are much older are either classified as satisfactory or fair. When analysis of variance was performed on this variable of IA classification, the result is statistically insignificant (see Table 2). This indicates that no statistically significant difference was found between and among the types of IAs in terms of their respective ages.

Farm size

Farm size refers to the average size of farm lot of members per IA. All three types of IAs have a minimum average farm size of 0.2 ha, whereas, the maximum average is 1.1 ha. Excellent-rated IAs have the smallest average farm size (M = 0.41, SD = 0.10), while fair-rated IAs have the largest (M = 0.65, SD = 0.19). This is substantiated by the result of the Welch's ANOVA presented in Table 2, which shows that the IAs are significantly different from each other with respect to their average farm sizes with $F (2, 37.49) = 15.71$, $p<0.01$. The post hoc test result shows that the excellent and fair-rated IAs and excellent- and satisfactory-rated IAs are significantly different from each other at $GH = -5.06$, $p<0.01$ and $GH = -3.57$, $p<0.01$, respectively. As such, the results show that small landholding farming households are mostly found among excellent-rated associations, whereas, large landholding farming households are mostly among satisfactory and fair-rated associations.

Farm location

Farm location relative to irrigation facility was measured by asking the respondents if their respective farms are located within the 1-km radius from the irrigation facility. On average, around 54 percent of all farmer-members per association have farm lots that are located near the irrigation facility. Among the three types of IAs, the excellent-rated IAs have the highest percentage of farmer-members (74%) whose farm lots are near the facility, while satisfactory-rated IAs have the lowest (41%). Based on the result of the analysis of variance, there are significant differences among the IAs in terms of farm location. Post hoc test results show that excellent IAs have significantly higher percentage of farmer-members whose farm lots are located near the irrigation facility compared to both satisfactory and fair IAs (Table 2).

Group size

Group size refers to the actual number of members per IA. In terms of membership, there are relatively small differences among the three types of IAs. The excellent-rated IAs have the least average number of members (M = 61.76, SD = 34.72), while fair-rated IAs have the largest (M = 73.67, SD = 56.58). On the other hand, among all the 63 IAs, the maximum number of members per IA is around 294, while the minimum number is 13. There is no statistically significant difference among the IAs with respect to the size of their respective groups (see Table 2).

Performance of the Communal Irrigation Systems

Cropping intensity

Cropping intensity was used as one of the two performance indicators of the CIS. This was measured as the percentage of the sum of the irrigated areas (dry and wet seasons) to the total firmed-up service area.

Excellent-rated IAs have the highest average cropping intensity (M = 95.91, SD = 3.82) among all the types of IAs (Table 3). Among the excellent-rated IAs, the minimum cropping intensity is at 90 percent while the maximum is at 100 percent.

Table 3. Performance indicators (cropping intensity and farm yield) by IA classification

Performance Indicator (Quantitative)	Fair	Satisfactory	Excellent	All
Cropping intensity (%)				
Mean	77.39	81.77	95.91	85.02
SD	8.66	7.41	3.82	10.49
Minimum	62.50	62.50	90.00	62.50
Maximum	89.40	93.00	100.00	100.00
Farm yield (sacks per hectare)				
Mean	59.30	60.03	97.36	72.24
Standard deviation	10.83	10.71	11.28	20.91
Minimum	43.80	35.70	74.70	35.70
Maximum	78.80	71.60	126.30	126.30

Table 4. Analysis of variance and post hoc test on the performance indicators (cropping intensity and farm yield) and IA classification

Performance Indicator	ANOVA		IA Classification Comparison	Post Hoc Test	
	F-ratio	p-value		t-ratio	p-value
Cropping intensity	58.50***	0.000	Satisfactory vs. Fair	1.76ns	0.196
			Excellent vs. Fair	8.97***	0.000
			Excellent vs. Satisfactory	7.77***	0.000
Farm yield	83.10***	0.000	Satisfactory vs. Fair	0.22ns	0.975
			Excellent vs. Fair	11.27***	0.000
			Excellent vs. Satisfactory	11.06***	0.000

Notes: ***, **, *, significant at 1 percent, 5 percent, 10 percent probability levels, respectively; ns = not significant

On the other hand, fair-rated IAs have the lowest cropping intensity (M = 77.39, SD = 8.66) during the same cropping seasons. In addition, their minimum cropping intensity is at 62 percent and the maximum is at 89 percent.

Based on the results presented in Table 4, the differences between the three IA classifications are statistically significant for the indicator cropping intensity, with Welch's F (2, 35.09) = 58.50, p<0.01. Post hoc analysis further reveal that the average cropping intensity of excellent IAs (M = 95.91) is significantly higher than that of fair (M = 81.77, GH = 8.97, p<0.01) and satisfactory IAs (M = 77.39, GH = 7.77, p<0.01). However, satisfactory and fair IAs are not significantly different from each other, suggesting that there is no means of knowing which of the two groups have higher or lower cropping intensity.

Various factors could explain these results. One possible explanation why cropping intensity is significantly higher in the excellent IAs is the firmed-up service area. The formula for computing cropping intensity suggests that it is inversely related to the size of the irrigated area, i.e., firmed-up service area. Note in the previous discussion that excellent IAs have smaller firmed-up service areas, which would explain why cropping intensity for these associations are significantly higher than that of IAs that have larger irrigated areas. Likewise, both satisfactory and fair IAs have larger firmed-up service areas; this could be the reason why these groups of IAs have relatively lower cropping intensities. However, there is no significant difference between these two groups of IAs with respect to this performance indicator.

Determinants of cropping intensity

Table 5 shows the estimation result of Tobit regression using cropping intensity as the dependent variable. The mean VIF is equal to 1.30,

Table 5. Estimated results of Tobit regression indicating the determinants of cropping intensity

Predictor	Coef.	Std. Error	T-value	P-value
Constant	78.066***	6.180	12.63	0.000
Monetary contribution	0.032ns	0.037	0.87	0.391
Labor contribution	0.127***	0.035	3.60	0.001
Firmed-up service area	−0.056ns	0.038	−1.46	0.149
Age of the association	0.119ns	0.119	0.99	0.324
Farm size	−11.217**	5.465	−2.05	0.045
Farm location	0.118*	0.066	1.80	0.078
Group size	0.007ns	0.022	0.32	0.749

Notes: ***, **, * significant at 1 percent, 5 percent, 10 percent probability levels, respectively; ns = not significant

which indicates that the model does not suffer from multicollinearity. Robust standard errors were used to control for heteroscedasticity. In terms of model specification, the Tobit model used for estimating the determinants of cropping intensity was correctly specified. Among the predictors of cropping intensity, labor contribution, farm size, and farm location are the only ones found to be statistically significant.

Table 5 shows that labor contribution is significant at 1 percent probability level, which implies that a one-percentage-point increase in the percentage of farmer-members who volunteer labor to their IAs would increase the value of cropping intensity by 0.13 percent. Although the effect of labor contribution on cropping intensity is small, the result is still highly expected. Whenever farmers participate in collective activities (e.g., cleaning and rehabilitating irrigation canals) in order to maintain these irrigation infrastructures, these facilities will accordingly perform optimally, thereby resulting in higher rate of cropping intensity.

Similarly, farm size is statistically significant at 5 percent probability level and is negatively associated with cropping intensity. This suggests that when farm size increases by 1 ha, the value of cropping intensity would fall by around 11 percent. The significant results and signs are consistent with the expectation of the study. When farm size is relatively smaller, cropping intensity would be much higher as opposed to when farm size is relatively larger. This corroborates the result presented previously regarding the sociodemographic attributes of the different IAs. Accordingly, the excellent IAs in this study have smaller farm sizes compared to those of the satisfactory and fair IAs. Cropping intensity is likewise much higher among excellent IAs than in other IA groups.

Lastly, farm location is a significant determinant of cropping intensity at 10 percent probability level. The result implies that a one-percentage-point increase in the percentage of farmer-members whose farm lots are located within the 1-km radius of the irrigation facility would increase cropping intensity by around 0.12 percent. This result is consistent with the expectation since it would be much easier to get irrigation water when farm lots are located near the irrigation facility.

Farm yield

Another quantitative performance indicator used in this study is farm yield, which was measured as the number of sacks of unmilled rice per hectare for both dry and wet seasons. Excellent-rated IAs have the highest farm yield during the past two cropping seasons (M = 97.36, SD = 11.28) with a minimum of 74.7 sacks/ha and a maximum of 126.3 sacks/ha (see Table 3). Meanwhile, satisfactory- (M = 60.03, SD = 10.71) and fair-rated IAs (M = 59.30, SD = 10.83) have almost the same farm yields. There is a relatively huge gap between the farm yield of excellent-rated IAs and satisfactory- and fair-rated IAs in the last two cropping seasons of 2017. The difference in farm yield between the two types of IAs is around 37 sacks/ha.

Farm yield was also found to be statistically significant using one-way ANOVA, $F(2, 60) = 83.10$, $p<0.01$ (see Table 4). This means that average farm outputs among these IA classifications are significantly different from each other. Tukey's post hoc analysis show that similar findings can be observed with respect to farm yield; excellent IAs have significantly higher farm yield (M = 97.36) compared with those of either fair (M = 59.30, Tukey = 11.27, $p<0.01$) and satisfactory IAs (M = 60.03, Tukey = 11.06, $p<0.01$). However, there is no statistical difference between fair and satisfactory IAs in terms of farm yield.

The difference in farm sizes could be one of the reasons for the statistical differences between the IA groups. Based on how this indicator is computed, average production is inversely related to farm size; thus, farm yield falls as the farm increases in size. This could be attributed to the law of diminishing returns, in which increasing the level of an input, while holding others fixed, would result in diminishing production rate. Among the IA classifications, excellent IAs have smaller average farm sizes compared with satisfactory and fair IAs, and the differences among these groups are significant. It can thus be expected that excellent IAs tend to have higher average yield than the satisfactory and fair IAs whose average farm sizes are larger.

Determinants of farm yield

Table 6 presents the results of the OLS estimation that indicate the significant determinants of farm yield as a performance indicator of CIS. Since the same set of independent variables was used for cropping intensity and farm yield, the result of the VIF reveal the same result. In terms of model specification, the OLS estimation for farm yield was also correctly specified. The following independent variables are statistically significant and have consistent expected signs: labor contribution, firmed-up service area, age of the association, farm size, and farm location. Among the seven predictors of the model, only monetary contribution and group size are statistically insignificant.

Table 6 shows that labor contribution, as a proxy for collective action, is statistically significant at 1 percent probability level and is positively associated with farm yield. This means that if the percentage of farmer-members who contribute labor to the IAs increases by 1 percent, farm yield also rises by 0.25 sacks/ha. This result is expected because when farmers contribute collectively for the operation and maintenance of their respective

Table 6. Estimated results of OLS regression indicating the determinants of farm yield

Predictor	Coef.	Std. Error	T-value	P-value
Constant	78.066***	6.180	12.63	0.000
Monetary contribution	0.032ns	0.037	0.87	0.391
Labor contribution	0.127***	0.035	3.60	0.001
Firmed-up service area	–0.056ns	0.038	–1.46	0.149
Age of the association	0.119ns	0.119	0.99	0.324
Farm size	–11.217**	5.465	–2.05	0.045
Farm location	0.118*	0.066	1.80	0.078
Group size	0.007ns	0.022	0.32	0.749

Notes:
Prob > F = 0.0000
***, **, * significant at 1 percent, 5 percent, and 10 percent probability levels, respectively; ns = not significant
OLS = ordinary least squares

irrigation systems, they would produce more due to improved irrigation facilities.

On the other hand, firmed-up service area has a significant but negative effect on farm yield. This means that a 1-ha increase in firmed-up service area would reduce farm yield by 0.24 sacks /ha while holding all other factors constant. This result is highly expected because a larger firmed-up service area needs more irrigation water to ensure that output per area will remain constant or will increase. If service area expands without the corresponding improvement in the capacity of irrigation system, then output per area would decrease, all other things being equal.

Age of the IA is also statistically significant at 1 percent probability level. A one-year increase in the age of an IA would increase average farm output by 0.72 sacks/ha. The significant and positive influence of an association's age on output is consistent with the hypothesis of this study and on the findings of previous studies on irrigation systems. According to literature, older IAs tend to have higher farm output because they have more experience in managing the irrigation system. Having more experience in managing this type of resource can mean that the IA can manage the irrigation facility better; thus, farm yield would also increase given that all other factors are constant.

Farm size is also a statistically significant determinant of farm yield at 10 percent probability level. The sign and significance of this variable are consistent with the expectation that a 1-ha increase in farm lot would decrease average yield by around 18 sacks/ha. This confirms the result presented earlier about the relevance of farm size in explaining why excellent IAs have much higher farm yield than the rest of the IAs. Most members of this group have smaller farm areas than those who belong in either satisfactory or fair IAs.

Lastly, farm location relative to the irrigation facility is statistically significant at 10 percent probability level. Table 6 shows that if a farm lot is within the 1-km radius of the irrigation facility, average production would be higher by 0.18 sacks /ha. The positive and significant influence of this variable on the dependent variable is consistent with the hypothesis that those farms that are closer to the irrigation facilities have more access to irrigation water than those that are farther away from these facilities. A well-irrigated farm tends to have higher production than those that are not since water is one of the major inputs in agricultural production.

The results of this study imply that collective action is an important factor in explaining the performance of excellent-rated IAs. Labor and monetary contributions, which were used as proxies for collective action, are higher in the excellent-rated associations than in the satisfactory and fair-rated IAs. The significance of collective action in addressing the use of a common-pool resource such as an irrigation system is proven to be consistent with the existing literature. For instance, Tsusaka et al. (2015) cited that farmers' free-riding behavior in using the irrigation facilities was voluntarily corrected through the emergence of social norms. These social norms developed from the farmers' collective experiences in managing their own irrigation system. However, in some cases, government intervention is still needed in order to promote collective action among resource users. Muchara et al. (2014) argued that for farmers to participate in collective action, they must be exposed to various government programs such as water management training and other capacity building activities.

Conclusions and Recommendations

Among the three classifications of IAs managing the CISs in Bohol, Philippines, the excellent-rated associations perform the best in terms of cropping intensity and farm yield. However, the ANOVA results and post hoc tests on both indicators have shown that there are no significant differences between satisfactory and fair IAs. By examining the attributes of the IAs, excellent-rated IAs have the following results: highest percentage of monetary and labor contributions from their members and relatively smaller, average firmed-up service area and farm size. These factors have proven to be necessary for an irrigation system to perform better in terms of cropping intensity and farm yield. The estimation results using Tobit and OLS have shown that these factors that characterize the excellent-rated IAs are significant in influencing the performance indicators of CIS.

With respect to the effects of collective action on the performance of CIs, only labor contribution is significant in determining cropping intensity and farm yield. One possible explanation for the insignificant effect of monetary contribution on the performance indicators could be the amount of monetary payments made by farmer-members. Although farmers contribute monetarily, low amount of payment might still be insufficent to operate and maintain the irrigation facilities. Further studies could thus be done to determine whether the amount of monetary contribution would significantly influence performance of the irrigation system.

Given the foregoing results, two recommendations can be drawn from the study:

1. *Encourage the collection of monetary payments from farmer-members.* Although the Free Irrigation Service Act of 2018 is already in effect, IAs must still collect monetary contributions from their members to have their own source of funds, instead of relying and waiting for the government. Nonetheless, the IAs would still find it difficult to operate and maintain the facilities regularly even if the government subsidizes their operations, without the IAs' own funding source. The results have shown that most of the IAs that receive monetary contributions from their members are excellently rated. This suggests that IAs that still collect monetary contributions from their members perform better than those that do not.
2. *Promote labor contribution among farmer-members*. This study has shown that labor contribution is one of the significant determinants of cropping intensity and farm yield. Almost all (90%) of the farmer-members who belong to excellent-rated IAs contribute their labor voluntarily for the operation and maintenance of their irrigation facilities. However, less than half of the farmer-members from the satisfactory- and fair-rated IAs contribute labor to their associations. This worsens the performance of these IAs; aside from the lack of monetary contributions from their members, they also fall short on labor contribution. If farmer-members do not participate in neither monetary nor labor contributions, then the performance of their irrigation systems would suffer. Even if the members give only minimal monetary contributions, if most members contribute labor for the operation and maintenance of their irrigation facilities, the performance of irrigation systems could still improve.

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Appendices

Table A1. Tobit estimation results for cropping intensity

Tobit regression

Number of obs. = 63
$F(7, 56)$ = 9.27
Prob > F = 0.0000
Log pseudolikelihood = −202.40877
Pseudo R^2 = 0.0902

Cropping_Int	Coef.	Robust Std. Error	t	P>|t|	[95% Conf. Interval]	
Money_Contrib	.0317307	.0366812	0.87	0.391	−.0417505	.1052119
Labor_Contrib	.1266299	.0351529	3.60	0.001	.0562102	.1970497
FUSA	−.0556995	.0380862	−1.46	0.149	−.1319954	.0205963
IA_Age	.1186987	.1193529	0.99	0.324	−.1203939	.3577914
IA_FarmSize	−11.2172900	5.4649890	−2.05	0.045	−22.1649800	−.2696025
IA_GrpSize	.0070396	.0219125	0.32	0.749	−.0368565	.0509357
IA_DistFarm	.1184249	.0659410	1.80	0.078	−.0136709	.2505206
_cons	78.0657400	6.1801310	12.63	0.000	65.6854500	90.4460300
/sigma	8.3665660	.7234035			6.9174150	9.8157170
0	left-censored observations					
55	uncensored observations					
8	right-censored observations at Cropping_Int >= 100					

Appendix Table 2. Link test for model specification of cropping intensity

Tobit regression

Number of obs. = 63
LR χ^2 = 40.30
Prob > χ^2 = 0.0000
Log pseudolikelihood = −202.32619
Pseudo R^2 = 0.0906

Cropping_Int	Coef.	Std. Error	t	P>|t|	[95% Conf. Interval]	
_hat	−.2065070	2.9707210	−0.07	0.945	−6.1468	5.7338160
_hatsq	.0069672	.0171399	0.41	0.686	−.02731	.0412406
_cons	51.7904700	127.9035000	0.40	0.687	−203.9683	307.5493000
sigma	8.3574900	.8165229			6.72476	9.9902280
0	left-censored observations					
55	uncensored observations					
8	right-censored observations at Cropping_Int >= 100					

Appendix Table 3. OLS estimation results for farm yield

Source	SS	df	MS	
Model	15869.0028	7	2267.000400	Number of obs . = 63
Residual	11243.9488	55	204.435433	*F*(7, 55) = 11.09
Total	**27112.9516**	**62**	**437.305671**	Prob > *F* = 0.0000
				R-squared = 0.5853
				Adj. *R*-squared = 0.5325
				Root MSE = 14.298

Farm Yield	Coef.	Std. Error	t	P>|t|	[95% Conf. Interval]	
Money_Contrib	.0223173	.0580407	0.38	0.702	−.0939989	.1386335
Labor_Contrib	.2515971	.0606189	4.15	0.000	.1301141	.3730802
FUSA	−.2359377	.0771138	−3.06	0.003	−.3904771	−.0813983
IA_Age	.7183438	.2119131	3.39	0.001	.2936605	1.1430270
IA_FarmSize	−18.1660400	10.15606	−1.79	0.079	−38.5192300	2.1871500
IA_GrpSize	.0614037	.0396215	1.55	0.127	−.0179995	.1408069
IA_FarmLoc	.1780347	.1023916	1.74	0.088	.0271626	.3832320
_cons	56.1814800	10.18703	5.52	0.000	35.7662300	76.5967400

Appendix Table 4. Link test for model specification of farm yield

Source	SS	df	MS	
Model	16163.9002	2	8081.9510	Number of obs . = 63
Residual	10949.0514	60	182.48419	*F*(2, 60) = 44.29
Total	27112.9516	62	437.305671	Prob > *F* = 0.0000
				R-squared = 0.5962
				Adj. *R*-squared = 0.5827
				Root MSE = 13.509

Farm Yield	Coef.	Std. Error	t	P>|t|	[95% Conf. Interval]	
_hat	−.0885675	.8630016	−0.10	0.919	−1.814828 0	1.6376930
_hatsq	.0074451	.0058567	1.27	0.209	−.0042699	.0191602
_consq	37.9095000	30.8579700	1.23	0.224	−23.8156400	99.6346300

Appendix Table 5. Test for multicollinearity for the independent variables

Variable	VIF	1/VIF
IA_FarmLoc	1.56	0.641486
Labor_Cont~b	1.44	0.694191
FUSA	1.31	0.764044
Money_Cont~b	1.30	0.767005
IA_FarmSize	1.23	0.813146
IA_GrpSize	1.21	0.828476
IA_Age	1.07	0.932506
Mean VIP	**1.30**	