ECONOMIC ANALYSIS ON BULK HANDLING OF MINDANAO CORN GRAIN TO MANILA AND CEBU, PHILIPPINES

Gigi B. Calica[1] and Nancy L. Eleria[2]

[1] Philippine Center for Postharvest Development and Mechanization (PHilMech), CLSU Compound, Science City of Munoz, Nueva Ecija, Philippines
[2] Graduate School, University of Santo Tomas, Espana, Manila, Philippines
Corresponding author: gigi_calica@ yahoo.com

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ABSTRACT

The study aimed to assess the economic feasibility of an integrated bulk handling system for yellow corn grains produced from Mindanao and marketed in Manila and Cebu. It is meant to address the problems on production and marketing inefficiencies of the Philippine corn industry. The present practice is characterized by low adoption of modern technologies, high postharvest losses, and high transport and marketing costs as a result of inadequate market infrastructures. The government is promoting the adoption of bulk grain handling technology to reduce postproduction costs and losses. The general objective of the study is to establish the social benefits that society could receive from the adoption of the bulk handling technology by comparing it to the traditional method. Using triangulation method of collecting data and employing value chain, financial and economic analyses, the study compared the traditional and the bulk handling systems. Results revealed that the bulk handling chain is better-off however; multiple comparison tests of income indicated that farmer-clients/adopters of bulk handling were worse-off because of the non-inclusion of the social benefits. The willingness of farmers to pay for bulk processing is higher if they are adopting the technology while lower for non-adopters. Price gap of the willingness-to-pay for adopting the technology could be covered by the social benefits from the project. A positive net present value and net social benefit (NSB) signified that this government intervention is worthwhile.

Key words: net social benefit, postharvest losses, willingness-to-pay

INTRODUCTION

Corn *(Zea mays L.)* is the second most important crop, after rice, in the Philippines. Two types of corn are grown in the country, white and yellow corn. Corn is consumed as a staple in the form of milled white corn grits by about 20 percent of Filipinos mostly from the Visayas islands. Major corn producing areas are mostly from Cagayan Valley in Luzon island and Mindanao island (Fig. 1). On the other hand, yellow corn is predominantly used as feed ingredients. It accounts for about 70 percent of livestock mixed feeds and 25 percent are processed as corn starch, corn oil, gluten and snack foods (Lantican, 2009). Based on the National Statistical and Coordinating Board (NSCB), livestock and poultry integrated sector accounts for 26.95 percent of the gross value added in agriculture, fishery and forestry in 2011 at constant prices contributing around USD14,525.31 billion (USD1 = PhP43.31 in 2011).

Some 1.5 million farmers depend on corn as major source of livelihood. This is in addition to transport services, traders, processors and agricultural input suppliers who directly benefit from corn production, processing, marketing and distribution (de Luna, 2012).

Fig. 1. Map of the Philippines

The Philippine corn industry has great opportunities because local demand is steadily increasing because of the annual growth rates of the local livestock by 1% and poultry by 5% (BAS and LDC, 2012). Further, importation of corn will be scarce because of the shift in the thrust of foreign-producing countries to use corn bio-fuels. However, the Philippine corn industry has been plagued by production and marketing inefficiencies which can be attributed to low adoption of modern corn production technologies, high postharvest losses, and high transport and marketing costs because of inadequate market infrastructure (Lantican, 2009).

In the Philippines, the government provides strong support in the form of technical assistance, partial input subsidy, postharvest and infrastructure upgrading, research and development budget, all aimed at improving the corn subsector.

In 2007, under the Corn Program of the Department of Agriculture (DA), a PhP40 million project Corn Processing and Trading Center (CPTC) of the National Agribusiness Corporation (NABCOR) partly adopted the bulk grain handling technology on the processing level. At present 13 CPTC projects are being operated nationwide. Seven of these are located in Mindanao. Now, the project is being operated and financed by the government showcasing bulk handling system from farm in corn in cobs to dry shelled corn grains ready for market.

The objectives of this paper are to describe the traditional and the bulk handling systems, determine if the bulk handling system of corn grain from Mindanao to Manila and Cebu has reduced costs and postharvest losses incurred as well increased the income, and establish the net social benefit of the project.

Theoretical Framework

A government policy that made at least some people better-off, while making nobody worse-off, would unambiguously improve social welfare; in economic theory such a policy is termed Pareto efficient. However, in reality such policies rarely exist, and a requirement for Pareto efficiency would result in policy inertia. A more practical requirement is that a policy should only be implemented when those who gain from the policy could compensate those who lose, and still be better off. Such a policy is said to offer a potential Pareto improvement (Barr, 2012).

The aim of cost-benefit analysis (CBA) is to provide a framework for assessing the ability of a project to offer a potential Pareto improvement. In undertaking a CBA, the analyst estimates all of the costs and benefits of a policy proposal in monetary terms for ease of comparison. If the benefits are greater than the costs, that is if there is a net social benefit, then in theory the gainers from the proposal would be able to compensate the losers and still be better-off, and the policy represents a potential Pareto improvement (Boardman et al, 2006).

Social benefits/costs analysis is a tool used by policy makers to systematically evaluate the impacts to all of society resulting from individual decisions. This is more quantitative analysis of social benefits and costs, where a monetary value is placed on the benefits and costs to society of individual decisions (Australian Government, 2007).

Previous studies on bulk handling in the Philippines were on the development of an appropriate bulk handling system for corn at the farmer-cooperative level of operation conducted by Bermundo et al. (2001) which recommended the potential areas where this system could be introduced in the collection and handling grain during harvesting, shelling, drying, storage and marketing. Further, Joaquin et al (2005) revealed that the introduction of bulk handling facilities and systems in Bukidnon resulted in a decrease in total postharvest losses, better quality in terms of aflatoxin contamination especially during wet season and increased financial performance of the cooperative because of the premium price of produce obtained.

In Canada and China, Fan and Jayas (2008) compared the grain distribution and handling of the two countries and showed how the inefficiencies were addressed. In Canada, bulk grain handling and transportation is practiced and has well developed mechanization and computerization while in China it has been developed through the implementation of the Grain Distribution and Marketing Project (GDMP), initiated in 1992 and completed in 1999 which improved the efficiency of moving grain from surplus to deficit areas and to shift from bag to bulk handling and eventually achieved a significant reduction in grain distribution costs and losses.

Unlike the previous studies in the Philippines, where the research focused on the bulk handling system on the farmer-level operation, this study assessed the economic feasibility of an integrated bulk handling system for yellow corn grains produced from Mindanao to Manila and Cebu to achieve the reduction in grain distribution costs and losses as of that in Canada and China.

METHODOLOGY

The research used data and information from survey, key informant interviews, focus group discussions and available secondary data. The research method consists of qualitative and quantitative methods for interviewing farmers, traders, processors, shippers, consignees/distributors, feedmillers, farmer's cooperative officials, and government officials. Combination of individual interviews and group discussions were likewise employed. Moreover, this study compared and analysed the value chain activities, financial and economic aspect s of the traditional and the bulk handling system.

The information from the survey was analysed and presented using descriptive, means and percentages. Value chain mapping was done to show the commodity flow and activities done by the farmer, the different market intermediaries up to the consumer using the traditional system and the bulk handling system. Financial and partial budget analyses were done on prices, incomes and marketing margins of the different market intermediaries along the chain and were compared on per kilogram basis. Multiple comparative tests were employed to know who among the actors were spending or earning more. Moreover, social benefits such as reduction postharvest losses, saved time and other cost were computed on per hectare basis.

The study was conducted in Mindanao particularly in Talakag, Bukidnon and Banga, South Cotabato where CPTC projects of the government were located. These represented the six operational CPTC projects in Mindanao with same component facilities, operational scheme of implementation, and bulk handling processing for corn. Through stratified random sampling, 344 farmer-clients or adopters of bulk handling system in the NABCOR project and 175 farmer-non-clients or non-adopters, 30 traders, 13 processors/integrators, 13 shippers, 2 consignees/distributors, and 23 feed millers/end-users were interviewed through the aid of structured questionnaire.

For this study, social benefits are the reduction in postharvest losses, saved time and other costs and good price for good quality product.

Postharvest loss reduction (from harvesting to marketing of the traditional against bulk handling system) is determined by the perception of the key actors involved in a particular activity (Equation 1).

$$\text{Postharvest lossreduction} = (L_{har}+L_p+L_h+L_{sh}+L_d+L_m)_{\text{non-adopter}} - L_{har}+L_{hp}+L_{sh}+L_d+L_m)_{\text{adopter}} \quad \text{Eq. (1)}$$

Where:

L_{har} = losses in harvesting
L_{hp} = losses in hauling and piling
L_{sh} = losses in shelling
L_d = losses in drying
L_m = losses in marketing

Further, time saved in adopting bulk handling system is computed based on the reduced man-days between the two systems (Equation 2) as well as the other costs. Finally, net social benefit is assessed based on the decision rule, if NSB>0 bulk handling system for corn from Mindanao to Manila and Cebu project of the government is worthwhile while NSB<0 meant otherwise (Equation 3).

$$\text{Time saved from harvesting to marketing} = (\text{Man-days/ha}_{\text{traditional}} \times \text{labor cost/day}) - (\text{man-days/ha}_{\text{bulk handling}} \times \text{labor cost/day}) \quad \text{Eq. (2)}$$

$$\text{Net Social Benefit} = [(Q_{\text{grains/ha}} \times P_{\text{grains/kg}}) + (L_{\text{bulk handling/ha}} \times P_{\text{grains/kg}}) + (M_{\text{bulk handling}} \times P_{\text{labor/day}}) + (Sk_{\text{shipment/ha}}+H_{\text{shipment/ha}})] - [(Q_{\text{cobs/ha}} \times P_{\text{grains/kg}}) + (Dep_{\text{bulk handling/ha}}) + (Proc_{\text{processing cost/kg}} \times Q_{\text{grains/ha}})] \quad \text{Eq. (3)}$$

Where:

$Q_{\text{grains/ha}}$ = quantity of corn grains per hectare
$P_{\text{grains/kg}}$ = price of corn grains per kilogram
$Q_{\text{cobs/ha}}$ = quantity of corn cobs per hectare
$P_{\text{cobs/kg}}$ = price of corn cobs per kilogram
$L_{\text{bulk hanlding/ha}}$ = postharvest loss reduction per hectare using bulk handling system

$P_{grains/kg}$ = price of corn grains per kilogram
$M_{bulk\ handling}$ =man-days saved per hectare using bulk handling system
$P_{labor/day}$ = price of labor per day
$Sk_{shipment}$= reduction in cost of sacks during shipment per hectare
$H_{shipment}$= reduction in handling cost during shipment per hectare
$Dep_{bulk\ handling}$ = depreciation of investments for bulk handling/kg
$Proc_{processing\ cost/kg}$ = processing cost per kilogram for bulk handling

RESULTS AND DISCUSSION

The Chain Map

Traditional system key actors and activities done.The actors involved in the Mindanao corn grain value chain are the farmers, traders, processors/integrators, shippers, consignee/distributor, and feedmiller/end user.

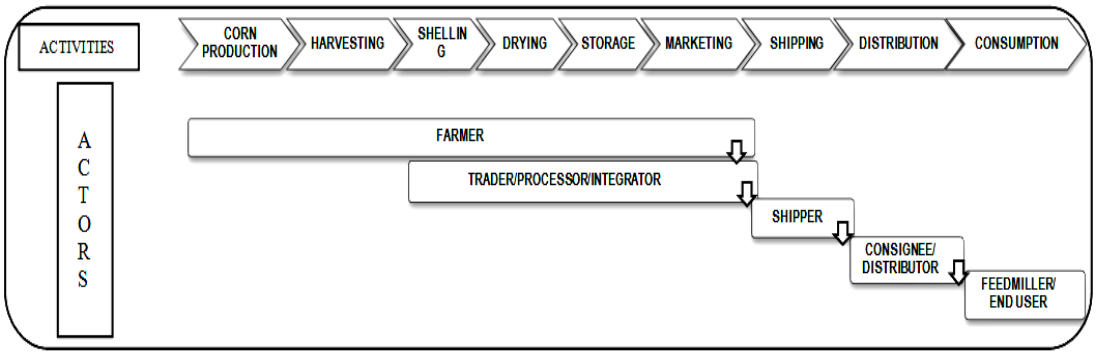

Fig. 2. Yellow corn grain value chain key actors and activities done from Mindanao to Manila and Cebu, traditional system, 2012

The actor involved in the production of corn is the ***farmer***. He is likewise in-charge of the harvesting, shelling, drying and marketing of his produce.

The ***trader*** buys dried corn grains from the farmer and delivers this to the processor/integrators. The ***processor/integrator*** processes corn grains into animal feeds for own livestock requirements or for commercial purposes, sometimes re-drying corn grains that are not properly dried (with MC higher than 14%). He is one of the sources of the ***shipper*** who supplies corn grains in Manila and Cebu. The shipper has contacts in these demand areas. The ***consignee/distributor,*** who upon receiving the corn grains at the port of destination, distributes the product to the ***feedmiller/end user*** who uses grains as one of the ingredients for the animal feed formulation.

Bulk handling key actors and activities done. The actors involved in the Mindanao corn grain bulk handling value chain are the farmers, processors, shippers, and the feed miller/end user (Fig. 3).

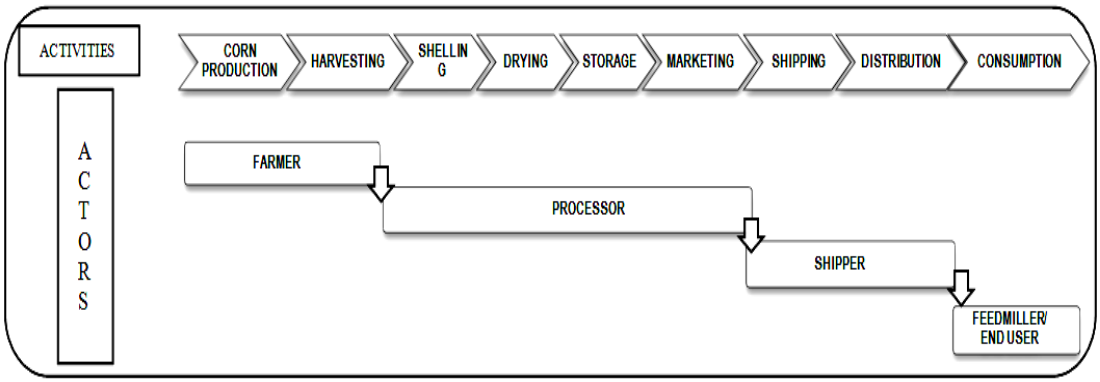

Fig. 3. Yellow corn grain value chain key actors and activities done from Mindanao to Manila and Cebu, bulk handling system, 2012

The actor involved in the production of corn is the ***farmer***. He is likewise in-charge of planting and harvesting his produce. The ***processor*** buys corn on cobs from the farmer and mechanically processes them. He practices bulk handling system. He dries the corn on cobs (COC) from its initial moisture content down to 18 percent MC for around 36 hours, shells it and fully dries the corn grains into 14 percent MC for around four to six hours. After grain drying tempering of the corn grains follows for about 1 hour before loading them into the container vans for shipment to Cebu or Manila to the ***feedmiller/end user***. Note that traders and consignee/distributors are eliminated in the bulk handling system.

Costs and Income

Table 1 presents the costs incurred and the net income received by the different actors involved in the chain.

Table 1. Yellow corn grain value chain, Mindanao to Manila and Cebu, traditional system, 2012 USD/ kg

Actors	**Farmer**	**Trader**	**Processor/ Integrator**	**Shipper**	**Consignee/ Distributor**	**Feedmiller / End user**	**Total**
Costs, USD	339.11	14.36	30.83	32.09	8.45	2.11	426.95
Net Income, USD	155.41	12.67	33.36	16.89	12.67	*	231.00
Costs Share,%	51.54	2.18	4.69	4.88	1.28	0.32	64.89
Net Income Share, %	23.62	1.92	5.07	2.57	1.93	-	35.11
TOTAL	**75.16**	**4.10**	**9.76**	**7.45**	**3.21**	**0.32**	**100.00**

Exchange rate: USD1 = PhP42.23 *Final product is in animal feeds not in corn grains

In Mindanao, the farmer incurred the highest cost at around 51.54 percent cost share as well as the highest net income received23.62 percent share in the entire chain. On the other hand, the feedmiller had the least cost incurred at 0.32 percent cost share in the chain. The consignee/distributor

received the least net income share in the chain. Cost share in the entire chain was at 64.89 percent while net income share was at 35.11percent.

Although the income per kilogram is high at the farmer level, they are not really earning that much because the volume they handled is only based on their area planted for the season. Hence, if we would look at the income received by each actor based on the volume handled, farmer would have the least income because of the smallest volume handled among the chain actors.

With bulk handling, the bulk of the costs and income have been absorbed by the processor because the farmer has been unloaded by several activities such as drying, shelling and storage as well as the traders who was eliminated in the chain**.** Thus, Mindanao's farmer cost incurred has been lowered to 49.57 percent whereas an increased in the trader's cost to around 190.40 percent compared to the traditional system. However, income for the farmer has been reduced to around 37.98 percent because this time his product is corn on cobs (COC) which commands lower price than corn grains resulting to additional income of around 567.60 percent for the processors. For the entire value chain, cost share incurred has been lowered to 31.45 percent because the number of actors has been reduced while income share has been increased by 45.70 percent because good quality product commands high price in the market (Table 2).

Though the farmer in terms of kilograms has the highest earnings but in terms of volume handled they would be earning the least among the chain actors.

Table 2. Yellow corn grain value chain, Mindanao to Manila and Cebu, bulk handling system, 2012 in USD/kg.

Actors	**Farmer**	**Processor/ Integrator**	**Shipper**	**Feedmiller / End User**	**Total**
Costs, USD	171.03	89.5	32.1	0.01	292.7
Net Income, USD	96.28	222.7	18.6	-	336.6
Costs Share,%	27.2	14.2	5.1	-	46.5
Net Income Share, %	15.3	35.2	3.0		53.5
Total	**42.48**	**49.5**	**8.1**		**100**

Exchange rate: USD1 = PhP42.23

*Final product is in animal feeds not in corn grains

Using the Statistical Package for Social Sciences (SPSS), a multiple comparison test was done to determine who among the actors involved in the chain spent and earned more. Table 3 indicates that actors such as the consignee/distributor, trader, shipper and trader/processor spent the same while the farmer-client (using bulk handling system) and farmer-non-client (using traditional system) spent more than the rest of the actors. However, between the farmer-client and the non-client, the former spent less than the latter which implies that farmers could reduce their costs with the bulk handling project.

Table 3. Multiple comparison test result of cost incurred by the different actors in the corn grain chain, 2012

	Type of Respondent	N	Subset		
			1	2	3
Student-Newman-Keuls[a]	Consignee/distributor	2	8.4500		
	Trader	30	16.8900		
	Shipper	16	32.9400		
	Processor/integrator	13	55.7400		
	Client	344		171.71	
	Non-client	175			333.23

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square (Error) = .920.

[a] Uses Harmonic Mean Sample Size = 8.806.

Further, a multiple test result of net income received by the different actors involved shows that the shipper, consignee/distributor and trader earned the same while the farmer- client and non-client and trader/processor received more than the others. Among the actors, trader/processor received the highest net income followed by the farmer non-client and the farmer-client. Since we only consider the monetary income, it indicates that farmer non-client/non-adopter is better off than the farmer client/adopter (Table 4). However, the bulk handling system has social benefits (i.e.,reduction in postharvest losses, activities unloaded from the farmers, time saved, and others)which could not be reflected on the tests, hence, economic analysis on the valuation of these has been done (See economic analyses).

Table 4. Multiple comparison test result of income received by the different actors in the corn grain chain, 2012.

	Type of Respondent	N	Subset			
			1	2	3	4
Student-Newman-Keuls[a]	Consignee/distributor	2	8.4660			
	Shipper	16	9.2906			
	Trader	30	16.2036			
	Farmer Client	344		104.0801		
	Farmer Non-client	175			182.02	
	Processor/integrator	13				252.274

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square (Error) = 1.632

[a] Uses Harmonic Mean Sample Size = 8.806.

Gross Margins

Table 5 shows that among the actors involved in the corn grain traditional system value chain, the farmer received the highest gross margin while the consignee/distributor received the least. The second highest gross margin received was the processor/integrator followed by the shipper and the trader. Gross margin distribution among the different actors closely matches with the total share distribution in the entire value chain. On the average, value added from the farm to the end user was around USD147/kg for the entire chain.

Table 5. Gross margin shares of the different stakeholders of the yellow corn grain value chain, Mindanao to Manila and Cebu, traditional system and bulk handling system, 2012, USD/kg

Chain Actors	Traditional System				Bulk Handling System			
	Selling Price (USD)	Buying Price (USD)	Gross Margin		Selling Price (USD)	Buying Price (USD)	Gross Margin	
			Amount (USD)	Share (%)			Amount (USD)	Share (%)
Farmer	498.74	-	-	77.2	267.74	-	-	42.6
Trader	526.19	498.74	27.45	4.2	-	-	-	-
Processor/ Integrator	578.55	526.19	52.36	8.1	578.55	267.74	310.81	49.4
Shipper	629.23	578.55	50.68	7.8	629.23	578.55	50.68	8.1
Consignee/ Distributor	646.12	629.23	16.89	2.6	-	-	-	-
Feedmiller/ End User		646.12	-	100		629.23	-	100

Exchange rate: USD1 = PhP42.23

However, in bulk handling system, the farmer sells COC which commanded lower price than corn grains, he received lower margins compared with that of the traditional system. Since the processor absorbed the activities unloaded from the farmers, margins were shared between them. Note that not only the farmer and processor benefited from the system but also the feed miller/end user who received lower price of corn grain which could be attributed to the less number of actors involved in the chain resulting to less marketing costs and more competitiveness in the market.

Further, total share distribution for the entire value chain and gross margin of the different actors in the chain implies that they concur with each other. On the average, value added from the farm to the end user was around USD361.49/kg for the entire chain which is almost triple than the traditional method.

Moreover, using partial budget analysis the bulk handling marginal costs and benefits have been assessed. Above we mentioned that with this technology farmers would have enough time to farm which could resulted to additional one cropping for them. Considering this as a potential additional return and the reduced costs, results show that the farmer adopter in Mindanao would be better off than the farmer non-adopter, with a positive effect of USD73.91/kg (Table 6).

Table 6. Partial budget analysis of adopting bulk handling system (selling corn on cobs) versus traditional method (selling dried corn grains), Mindanao, 2012 in USD/kg

Positve Effects (A)	Amount (USD)	Negative Effects (B)	Amount (USD)
ADDED RETURNS		**REDUCED RETURNS**	
Potential additional 1 cropping season	**96.28**	Non-adopter	155.41
REDUCED COSTS		Less: Adopter	96.71
Shelling	15.62		
Drying	9.71		
Transport	9.71		
Storage	1.27		
TOTAL REDUCED COSTS	***36.32***	***TOTAL REDUCED RETURNS***	***58.70***
TOTAL POSITIVE EFFECTS	***132.60***	***TOTAL NEGATIVE EFFECTS***	***58.70***
NET EFFECT (A-B)		**73.91**	

Exchange rate: USD1 = PhP42.23

Economic Analysis

The Project. The NABCOR projects in Mindanao would be used as the take-off point of the entire bulk handling system from production to the demand areas like Cebu and Manila. This would be in addition to its own requirement in Mindanao. Customized 20 footer container vans would be used in the bulk shipment of corn grains from Mindanao to Manila and Cebu.

The project would operate in 10 months per year and has a capacity of 26,000 MT of corn on cobs in a year (26 days/month operation). The government would provide the facilities and the working capital of USD 1,912 Billion. It would be operated for five to six years and turned over to an eligible cooperative which has the capacity to run the project.

Based on the feasibility study, at 70 percent utilization and marketing 60 percent of its product to the local market, 30 percent to Cebu and 10 percent to Manila, the project can recoup its investment within 2.49 years and with benefit-cost ratio (BCR) of 2.24. Further, an Internal Rate of Return (IRR) of 34.85 percent and a net present value (NPV) at 16 percent per annum of USD51.134 million indicates that this project is acceptable based on National Economic Development Authority's (NEDA) 15 percent hurdle rate (Table 7).

Break-even point price for local market is USD533.36/kg; for Cebu is USD572.64/kg; and for Manila USD592.91/kg while break-even point volume is 2.6 million kg/year for the local market, 914,799kg/year for Cebu market and 272,796 kg/year for Manila market. In terms of service area the project needs around 987 hectares to supply the corn on cobs requirement of the project.

Sensitivity analysis indicates that the project is more sensitive on the change in selling price of corn grains than in volume.

Table 7. Financial analysis and assumptions used for bulk handling scheme of the CPTC, Mindanao to Manila and Cebu, 2012

ITEM	AMOUNT, USD
INVESTMENT COST	**USD1,908 B**
Facility cost	USD1,655 M
Working capital	USD 253 M
Fixed cost, P year^{-1}	**USD 330.4 M**
Depreciation	108.2 M
Repair and Maintenance	15.1 M
Registration and licences	16.3 M
Interest on investment	165.5 M
Interest on capital investment	25.3 M
Variable cost, P year^{-1}	**USD 540.9 M**
Fuel, oil and grease	27.8 M
Salary and wages	64.2 M
Power cost	68.7 M
Water cost	0.8 M
Labor, transport and handling cost	374.7 M
Packaging material	4.8 M
Miscellaneous expenses	USD 5.4 M
TOTAL OPERATING COST	**USD 876.7M**
Volume processed, dry grains, kg year^{-1}	10,010,000
Buying price of COCs, USD kg^{-1}	244.93
Selling price, USD kg^{-1}	
Local market	565.88
Cebu	617.40
Manila	637.67
Gross income, USD year^{-1}	**USD 1,433.2 B**
Net income for the first year, USD year^{-1}	**USD 375.4 M**
Payback period, years	2.49
Internal rate of return (IRR) @ 16% p.a.	34.85
Benefit cost ratio	2.24
Net present value, USD	**USD 51,134 M**
Breakeven	
Selling price, USD kg^{-1}	
Local market	533.36
Cebu	572.64
Manila	592.91
Volume, dry grains, kg year^{-1}	
Local market	1,644,453
Cebu	576,036
Manila	171,776
Service area, ha year^{-1}	
Local market	427
Cebu	150
Manila	45

Willingness-to-pay for bulk processing. The willingness of farmers to pay for bulk processing is higher if they are already adopting the technology while non-adopters is lower because they based their answers on the direct costs incurred in the shelling and labor cost for sundrying of corn (Table 8). Thus, results indicated that willingness for adopting the bulk handling by the non-clients was USD17.71 kg^{-1}, than the actual fee of USD73.90 kg^{-1}, thus a negative price gap of USD54.90 kg^{-1} or negative price gap of USD 22.17 kg^{-1}.

Table 8. Willingness-to-pay of farmer for bulk processing of corn, 2012 USD/kg

Item	Actual Bulk Handling Fee	Willingness-to-pay for bulk handling	Price Gap
Farmer Client	73.90	84.46	10.56
Farmer Non-client	73.90	17.74	(54.90)
Average			**(22.17)**

Exchange rate: USD1 = PhP42.23

Postharvest Losses. The study determined postharvest losses through qualitative and quantitative bases. Qualitative is based its physical appearance (i.e., 14% moisture content, golden yellow in color and free from foreign matters) while quantitative losses is based on the weight loss.

Traders imposed price deduction of around one to three percent if the quality of corn grains did not meet requirements while price deduction of one to three percent based on the total weight for quantitative losses. If the product does not meet both the qualitative and quantitative requirements, price deductions would be based on whichever was higher.

Based on the farmers' perception, postharvest losses (from harvesting to marketing) of about 12.35 percent were incurred using traditional system while about 3.31 percent were incurred using bulk handling system. Hence, a reduction in postharvest losses of around 9.04 percent would be achieved by adopting bulk handling system (See NSB). Moreover, this implies additional corn supply for the industry.

Saved time and other costs. With the project, farmers would be able to save time hence, reducing man-days by 13.42 per hectare or savings of around USD85,008.99/ha or USD22.59/kg (See NSB). It is expected for the farmers to plant 3 times a year because they have more time in the farm considering that several farm activities have been unloaded. This redounds to additional corn supply for the industry and additional income for the farmers and other actors in the chain. With the project, costs on sacks and handling during distribution would be reduced as well.

Net Social Benefit (NSB).This was computed to reflect the social benefits from adopting bulk handling system. Results indicated that NSB was USD110,918.94 per hectare or USD29.48/kg. This shows that social benefits received by the society if they would adopt bulk handling could cover the average price gap of USD22.17/kg between the actual bulk handling fee and willingness for bulk processing (Table 9). Moreover, a positive NSB meant that this government project is worthwhile.

Table 9. Net social benefit from adopting bulk handling system for corn, Mindanao to Manila and Cebu, 2012

ITEM	Non-Adopter	Adopter	Per Hectare	Rate	Benefit, USD ha^{-1}	Costs, USD ha^{-1}
Volume/ha	3,763.11		3763.11	565.88/kg	2,129,468.69	
		7,526.21	7526.21	267.74/kg		2,015,067.46
Reduced postharvest losses	12.35	3.31	34,018.51	565.88/kg	192,506.72	
Saved man-days	31.75	18.33	13.42	6,334.50/ md	85,008.99	
Reduced sack costs	63	-	63	358.96/sack	22,614.48	
Saved Handling costs	15962.94	802.37			15,160.57	
Depreciation	-	23820.49				23,820.49
Processing costs	-	73.90	3763.11			278,093.83
TOTAL					**2,444,759.45**	**2,316,981.78**
NET SOCIAL BENEFITS					**USD 127,777.76 ha^{-1} or USD 33.96 kg^{-1}**	

Note: Volume ha^{-1} of COC = 7,526.21 kg; Volume ha^{-1}; corn grains = 3,763.11 kg
* Conveyor consumption of 10 kwh^{-1} at USD422.3 kwh^{-1} used for 45 min
Cost of sack = USD 358.96 pc^{-1}; One sack = 60 kg Handling cost sack^{-1} = USD 63.34 kg^{-1}

Problems and Constraints

Problems encountered by the farmers in their present corn production were the following: unfavourable weather condition, lack of finances and labor supply, high transport cost due to unpaved farm to market roads, the distance of their farm from the market, the low and fluctuating price of corn and lack of information. Other key actors aside from the shippers disclosed that they were receiving low quality of corn, supply shortage and high price. Shippers said that lack of infrastructure at the port was their primary problem.

CONCLUSIONS AND POLICY IMPLICATIONS

Bulk handling system reduced the costs incurred by the Mindanao corn farmers because of the activities unloaded from them and absorbed by the processors. However, this resulted to a decrease in the income of the farmers because of selling COC instead of selling in corn grains which commanded higher price. Moreover, processors earned more though they incurred higher costs in the bulk handling system. Consequently, the project has improved the entire value chain by reducing its costs and increasing its income. The positive net social benefit denotes that this government project is worthwhile.

Thus, to encourage the farmer non-adopters to bring their produce to the processing center and to serve as incentive for the adopters, a rebate or patronage refund should be implemented by the

processors. Furthermore, bigger processing center's capacities could lower processing costs which could encourage farmer non-adopters to sell their produce. Good quality product would mean a bigger chance to compete with Luzon products during their lean months and export to the neighboring Asian countries in the future.

Since the farmers are now concentrating on producing more corn supply, the government should continue to explore potentials in the industry and link this program both to the local and international market. In addition, the DA should continue to promote the use of moisture meter to accurately measure the MC of corn and meet the requirements of the market. The Department of Public Works and Highways meanwhile, should prioritize the farm to market road projects to address the problem on high transport costs. Government should also look into the capability of the domestic ports on handling bulk agricultural goods such as corn grains. Lastly, aggressive promotion through trainings, publications and other media forms on the adoption of bulk handling system for the corn industry must be implemented.

Results of the study can be valuable information to policy makers for making policy decisions that would support government plans in enhancing the competitiveness of the corn industry to confront globalization.

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