ECONOMIC VALUE OF IRRIGATION WATER: A CASE OF MAJOR IRRIGATION SCHEME IN SRI LANKA

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ABSTRACT

It is generally agreed that inefficient use of irrigation-water and poor performance of irrigation systems are critical issues; especially in the light of the apparent lack of water resources. This study attempts to determine the economic value of irrigation-water in a government properly managed irrigation project (GPMIP) by eliciting farmer's willingness to pay (WTP) using contingent valuation method followed by single bounded dichotomous choices. A stepwise backward binary multivariate logistic regression model was used to measure WTP and to determine the factors that influence the variation in WTP. Primary data were obtained from 367 farmer households in Nagadeepa irrigation schemes in dry zone. The estimated value of irrigation water was Rs. 5,275 ($40) per hectare per season which is 8.6 percent of net income in paddy farming per hectare at present in selected irrigation scheme. Further, if farmers can increase further their household farming income by 5.9%, it is possible to cover additional cost which would be driven due to pricing irrigation water and it is not an unreachable challenge with proper irrigation services. One of the most important policy implications of this study is the possibility of restructuring the existing irrigation pricing system by taking into account the economic value of irrigation water. Such policy reform can encourage farmers to use irrigation resources efficiently by motivating improvement in water management practices and generating revenue for operation, maintenance and capital replacement and irrigation sustainability in the country.

Keywords: *Water Pricing, Contingent Valuation, Willingness-to-pay, Irrigation Efficiency*

INTRODUCTION

There has been much debate in recent years about whether or not irrigation water should be regarded as an "economic good" and, if so, what that implies. However, in 1992, with Dublin conference it was confirmed that water should be treated purely as an economic good (Bhattarai *et al*., 2006). Economic literature has extensively discussed the role of economics in irrigation water management (Petra & Perry, 2006; Rogers *et al.*, 2002; Wegerich 2007). Some economists want to treat water in the same way as other private good, subject to allocation through competitive market pricing, while others want to treat water as a basic human need that should be largely exempted from competitive market pricing and allocation (Petra & Perry,2006). After irrigated water was recognized as an economic good, international donor agencies introduced new policy framework for their loanable funds on large-scale irrigation investment projects. World Bank includes new conditions with irrigation loans by implementing water pricing policies with large-scale irrigation project. Yet, the notion of desirable water pricing does not at all command consensus among economists,

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let alone policy makers (Johansson, 2000).

Irrigation is the backbone in Sri Lankan rural economy. Because, 25% of cultivable land and two million farmer families (65% of rural households) are engaging in paddy farming as their main occupation (Shantha, 2011a). Highly water-intensive rice cultivation consumes more than 70 percent of the total water allocated for food production in the country (Henegedara, 2002). According to policy makers irrigation is one of the most important strategic factors in the development of rural sector and it is playing central a role in poverty alleviation (Hussain & Hanjra, 2004). Hence, economically efficient way of water utilization has become a major challenge in irrigation during the last decades.

Sri Lankan irrigation schemes are divided into major, medium and minor schemes on the basis of land extent or command area (Thiruchelvan, 2009). Major irrigation schemes are defined as those that have a command area of more than 1,000 ha, while systems between 80 and 1,000 ha are considered to be medium irrigation schemes. Minor irrigation schemes are those with a command area 80 ha or less. The principle irrigated crop, paddy is grown on nearly 730,000 ha of land, and 389,000 ha of this total is grown under major irrigation schemes and 170,000 ha of this total is grown under medium and minor irrigation schemes (IWMI 2005). Remaining 171,000 ha, which is non-irrigable paddy land is sown by small scale paddy farmers under rain fed cultivation.

About one-third of the world's food supply is produced on 250 million hectares of irrigated land or less than one-fifth of the total cultivated area (Stewart & Nielsen, 1990). In developing countries, where two-thirds of farmers depend on irrigation and 50% of additional output during the last four decades produced by irrigated land (Barrow, 1991). However, over the past decades public investment in major, medium and minor irrigation systems has not yielded the expected results and the solution to the growing water crisis lies in the institutional reform of existing social system so as to manage the demand for water (Thiruchelvan, 2009). Although irrigation has enhanced agricultural production, most large scale systems have not generated the result expected by project planners, causing decline in public funding for major irrigation projects during last two decades (International Rice Research Institute, 2012). Poor performance has been caused by the failure of public agencies to collect funds from farmers to support operation and maintenance of large-scale irrigation schemes in developing countries (Johnson, 1990).

It is necessary to produce the maximum yield per unit area by using available water efficiently because irrigation water is rapidly diminishing around the world (Zhag *et al.,*2008). Rosegrant & Ringler (1993) recommend policy reforms including economic incentives for water conservation, water market and privatization of management functions. Gazmuri & Rosegrant (1996) suggest that well-defined and tradable property rights to land and water are required to the potential benefits of general economic reforms. Policy reform can encourage farmers to use irrigation and drainage resources efficiently by motivating improvements of water management practices (Wichelns, 1999).

There were extensive amount of literature where researchers have found those which have focused on the impotency of irrigation efficiency all over the world (Bandaragoda, 1998; Wichelns, 1999; Henegedara, 2002). Besides, the role of irrigated water pricing on irrigation optimization has been discussed by many researchers (Sivarajah & Ahamad, 2005; Bandara & Weerahewa, 2003; Herath & Gichuki, 2006; Upasena & Abegunawardana, 1993). However, in general Sri Lankan farmers still enjoy the free of charge irrigation facilities which are often provided by state sector organizations. It is the attitude of most Sri Lankan farmers that, it is the responsibility of the government to provide water to the irrigable land (Upasena & Abegunawardna, 1993). Since water is free of charge, water use has become inefficient and the demand for water has exceeded the optimum requirement at zero price. At zero price, water users leisurely support resource optimization objective in economics. Further, at zero price farmers use the water until the marginal productivity of water is driven to zero (Bos *et al*., 1990). In addition, it leads to uneven distribution of irrigation water among head-end farmers and tail-end farmers in irrigation systems. As head-enders consumed much more water at zero prices the tail-enders face massive water deficiency. It is becoming a very common practice in large-scale irrigation schemes where the tail end farmers receive a disproportionately small amount of irrigation water and at times no water at all, while the head-end farmers receive an unduly large share of canal water (Hussain *et al*., 2005). In fact, such disparity of water among farmers has caused poverty and income inequality in the system.

Furthermore, Irrigation is the most important strategic factor in the development in the rural sector in Sri Lanka and irrigation can play a central role in poverty reduction .The total public investment on irrigation was US$ 401 million within the previous two decades (1980-2000) and on average it was 8% of annual public investment in the same period. (IWMI, 2002). The share of operation and maintenance expenditure out of total irrigation investment is at around 4 percent over the last two decades (1990-2010) (Department of Irrigation, 2012). In 1984 the government implemented a new law for collecting Operational and Maintenance (O&M) charges from setter farmers in large-scale irrigation schemes. However, it was partly distorted by 90s and now it has totally disappeared from the system. On the other hand, if the O&M law reached target outcome, it was just enough to shelter the day- to-day maintenance only. Neither, rehabilitation nor capital cost was sheltered by O&M policy. In principle government accepted that the farmer should pay O&M cost while in practice it was never implemented properly among schemes over the past three decades or even at present. Besides, through O&M law, authorized state organizations failed to accomplish equity principles among upstream and downstream users.

Under these circumstances, the irrigation investments in Sri Lanka have not been playing a rational role on resource optimization. Therefore, one way to achieve an efficient allocation of water is to price its consumption correctly and reform water management policies to contend it. Correct measurement and policy reform can encourage farmers to use irrigation resources efficiently by motivating improvement in water management practices and generating revenue for operation, maintenance and capital replacement. Further, such policies that improve the distribution of water among farmers at head-end and tail-ends of delivery systems may increase aggregate output. In this, context, pricing irrigation water is essential for long-term sustainability of irrigated agriculture in Sri Lanka. Therefor the main objective of this study was to estimate the economic value of irrigation water under contingent valuation method and to determine the factors that influence the vitiation in willingness to pay decision of farmers in a selected irrigation scheme in the dry-zone of Sri Lanka.

MATERIALS AND METHODS

Model specification

The theoretical model of the study is based on standard microeconomics principles and empirical work cited in the literature review section. Contingent Valuation Survey (CVS) stimulate a market for a non-market good and obtain a value for the good, contingent on the hypothetical market described during the survey (Wedgwood & Sansom, 2003). Whittington (1998) stated that, ”*The economic concept that contingent surveys are trying to capture is the maximum amount that a respondent would be willing to pay for the proposed improvement in water service in the context of the existing institutional regime within which households are free to allocate their financial resources”*. According to ordinal utility theory willingness to pay is an amount that compensates utility after provision of the good or service in question and leaves the households on the same indifference curve

According to literature on the subject, there have been efforts to measure the value of non-market goods by applying contingent valuation method internationally. Because this is a tool to place an amount of the value on food and services that are typically not exchange in the market place. Another important reason behind the expressed reservations about the CV method is the potential divergence between responses and actual behavior. The emerging evidence shows that, the prediction from “hypothetical” CV scenarios seem to compare well with actual behavior (Cameron, 1998). Thus, CVM is an ideal tool to measure the price of irrigation water.

This study addresses the following constructs for carrying out a dichotomous choice framework which is the most common and popular form of CVM that is generally used for measuring value for non-market goods.

Empirical model and variables

The reduced form of a typical logistic probability model can be written in the following form:

$$\Pr[Y_{t=1}] = \frac{e^{\beta x}}{1+e^{\beta x}}$$

$$\Pr[Y_{t=1}] = \frac{e^{\beta 0+\beta 1 BID+\sum_{i=1}^{n}\gamma i Si+\sum_{j=1}^{m}\propto j Fj}}{1+e^{\beta 0+\beta 1 BID+\sum_{i=1}^{n}\gamma i Si+\sum_{j=1}^{m}\propto j Fj}}$$

Where,

Y= Dependent Variable: Households responses for WTP for irrigation water:

1= willing to-pay, 0 = Do not willing-to-pay

BID = Bid level (Rs/household per season)

F= Farming characteristics

LOC = Location of paddy field, (1) =Tail-end (0) = Otherwise

ISC = Irrigation scarcity: (1) = Do not have sufficient water for farming (0) = Otherwise

FIM = Farm Income: (Rs. Per household per month)

OWS = Ownership of paddy land: (1) = Owner (2) = Otherwise

EXT = Extent cultivated of paddy (Hectare per season)

S= Socio-economic characteristics

MIS = Main income source: (1) Farming (2) = Otherwise

EDC = Education: Respondents education level (lastly reached grade)

KWM= Existing knowledge of water management: (1) Good, (0) Otherwise

Site description

Nagadeepa irrigation scheme was selected for the study based on the degree of water risk in the dry season (*Yala Season*). This scheme is located around 13 km from *Mahiyanganaya* Town ship on the Bibile road, in *Budulla* District. Since it is located in the dry zone irrigated water supply is needed for systematic cultivation. It was set up in 1969 by Irrigation Department with 2,000 farmer families and approximately 1,765 ha of irrigable land. At present about 2,400 families are living in the area while authorized farmer families were around 1,440. The distribution network consists of 22.6 km of main channel, 30.6 km of distributary channels and 92 km of field channels. There are 24 distributaries and 303 field channels in the system. Each farmer was given 1.2 ha of irrigable extent and 0.4ha of high land when they have settled in the project in 1969. In wet season (*Maha Season*) around 1300 ha of irrigable land were cultivated. However, during dry season (*Yala Season*) the irrigable land were left uncultivated due to shortage of water.

Sampling framework

The target groups of the field survey were authorized paddy farmers in selected schemes. Their income mainly depend on agriculture and related activities, especially paddy farming. Thus, total sample population was 1,440 settler households in Nagadeepa irrigation scheme. Stratified random sample techniques were used to select the sample under several stages. At the first stage farmers were clustered as head, middle and tail based proximity of water sources to the irrigable land. Because, in practice, farmers whose fields are furthest from the water sources frequently have least secure water supply, while the farmers whose fields are closer to water source receive an unduly large share of channel water. The irrigation engineers and technical officers are involved in the development of head, middle and tail regions of each scheme. In the second stage sample size is determined under the Bartlet (2001) approach. The number of total sample calculated according to the number of CV versions to be tested, number of bids offered in a CV scenario and study budget. At the third stage total sample in the scheme is distributed among head, middle and tail clusters proportionally with respect to population of each cluster. At final stage systematic random sample techniques were applied to choose sample households from the sample frame and selected sample is presented in Table 01.

RESULTS AND DISCUSSION

Respondent's background

A summary of income and demographic variables of sample respondents is presented in Table 02. Of the 367 respondents interviewed, the average household consists of five family members. The average age of the respondents was around 52 years. A majority (95.8) of the households was Buddhist and the rest was Muslim. Almost all respondents were the heads of their households and owned the houses they lived. Only 66.5 percent households had electricity. Tube-well was one of the most common sources of drinking water for sample households and leaves were the main source of energy. Average paddy yield (Mt/ha) was 4.760 and net income from paddy farming was Rs 61,177($ 470) per hectare per season. However, average household net income from paddy farming was Rs. 59,560 ($458) per year. Total household annual net farm income and non-farm income were Rs 89,660 ($690) and Rs.125, 450 ($965), respectively. More than 85 percent farmers ware engaged in secondary occupation, mainly as skilled and unskilled labour in both agriculture and non-agriculture sectors. Non-agricultural employment mainly connected with textile and government forces based employments.

Contingent valuation of irrigation water

Two major questions were focused to measure the willingness to pay on irrigation water. A majority of the farmers (82 percent) replied positively to the first WTP question. They agreed (in principle) to a specific amount as value of irrigation water. The answers for first question were summarized as in Table 03. In contrast, 95% of tail-end farmers agreed to pay for irrigation water while the figure for head-enders was 68%. It was evident that more scarcity for common pool resources encourages users to value for it.

Table 01: Population and sample framework

Scheme	Clusters	No of Households	*Sample Size α=0.05,t=1.96
Nagadeepa	Head	530	133
	Middle	486	123
	Tail	424	121
Total		1,440	367

Source: Mahaweli Authority of Sri Lanka & Department of Irrigation (2011)
Note: *Sample size determined based on Bartlet approach. (Bartlet *et al*., 2001)

Table 02: Background of respondents

Variable	Sample Mean
Average Family Size	5.2 (1.8)
Respondents Age in Years	52 (8.9)
Average cultivated irrigated extent per Season	0.66 ha (0.54)
Average paddy yield (MT/Ha/Season)	4.760 (2,259)
Average net income from paddy (Rs./Ha/Season)	61,177 (23,564)
Average net income from paddy (Rs/Year/Household)	59,560 (7,612)
Average net income from Other Field Crops (Rs./Year/Household)	21,230 (8,356)
Average net income from perennial crops (Rs./Year/household)	5,650 (4,234)
Average net income from livestock (Rs./Year/household)	3,220 (768)
Average total net income from Farming (Rs./Year/household)	89,660 (15,626.9)
Average Income from Non-Farming (Rs./year/household)	125,450 (23,657.8)
Religion (% of Sample Buddhist)	95.8

*Note.*US$ 1.00 = Sri Lankan Rs 130 (as of September, 2013), Parenthesis are Std.Deviation
Source: Author's Calculation based on survey data, 2012.

Table 03: In principle willing to Pay for irrigation water

Type of farmers by Water Source	Sample Size	Agreed (%)	Disagreed (%)
Head-enders	133	68%	32%
Middle-enders	123	87%	13%
Tail-enders	121	95%	5%
Total	367	82%	18%

Source: Author's calculation based on field survey 2012

Since tail-end farmers were suffering from irrigation water, they value it much more and attempt to protect it. Those who were not willing to pay were subsequently asked in a follow up question as to why they would not do so. The results were summarized as in Table 04.

In general, majority of disagreed farmers highlighted that the existing difficulties faced in paddy farming do not permit paying for irrigation water. More specially, higher cost of production and low yield were highlighted as main reasons. Almost all farmers were aware that government was spending considerable amount of money for irrigation management. However, under existing situation they refused to pay for irrigation.

Out of 367 respondents 302 agreed (in principle) for paying irrigation water with proposed hypothetical model. A parametric logistic probability model was employed to estimate central tendency measures of WTP (Hanemann, 1984; Gunathilaka *et al*., 2007). The estimated WTP results are presented in Table 05. According to parametric logistic model the mean value of WTP is Rs.5,275 for per/ ha/season ($40/ha/season) for irrigation water. These results are close to the findings of Sivarajah (2005), who valued irrigation water as R.6,170 ($47) per/ha/season. Further, Renwick (2000) has valued irrigation water as Rs.6, 699 ($51) per/ ha/ season and that of the figure projected by Bandara and Weerahewa (2003) at Rs. 5,727.6 ($44) per hectare.

Factors explaining WTP for irrigation water

A stepwise backward binary multivariate logistic regression model was applied to determine the key factors associated with willing to pay decision of selected 367 responders. They were considered socio-economic and farming characteristics as well as existing water management practices. Initial model was run with 13 explanatory variables; however after the 9th iteration model was selected eight key factors which were mainly influenced for respondent's decisions. Selected variables and estimated parameters of the final model are presented in Table 06.

Interpreting the logistic coefficients

In this final model almost all the variables except constant have positive signs, indicating the positive relationship between both independent variables and predicted probability. The estimated coefficient reflects very important logical relations. As farmer paddy land reaches more towards tail-end regions, they have shown high commitment for WTP. Those who faced insufficient water for farming; they have reflected higher obligation for WTP than others. In contrast, both cases recall the fundamental rule of economics which elaborate the direct relationship between scarcity and competitive price of resources. Besides, if main income source is farming, farmer agreed with WTP rather than others. Those who cultivated their own land, they were more committed to WTP than other farmers. Further, as farm income and existing knowledge of water management increase WTP tend to increase. This result also indicates the universal fact that the knowledge enhances the awareness in value of scare environmental resources. Finally as extent cultivated and farm income increased, respondent's commitments to paying for irrigation increased. All those are consistent with theoretical expectation and empirical findings. In contrast, according to the Wald Test statistics all measured variables were statistically significant at least five percent. Wald Test statistics are commonly used to test significance of individual logistic regression coefficient. However, non-farm income, total number of family members, educational level of responder and happiness of household dropped from the model with backward iterations.

Metric independent variables

The most direct method of assessing the

magnitude of the change in probability due to each metric independent variable is to examine the exponentiated coefficient (Joseph *et al.,* 2010). The exponentiated coefficient minus one into 100 equals the percentage change in odds due to one unit change in an independent variable. The results of metric independent variables are presented in Table 07.

Table 04: Reasons for "disagreed to paying for water"

Main Reasons for Not WTP	%
Existing slimmer profit margin in paddy farming is not enough to pay	52
With paying for irrigation, paddy farming becomes impractical effort.	31
I don't have money to pay for irrigation, we are subsistence farmers.	12
Why should I pay, I have enough water.	5

Source: Author's calculation based on survey (2012)

Table 05: Mean WTP for irrigation water

Statistics	WTP for Irrigation Water (Rs./ha Per season)
Mean WTP[a]	5,275
Standard error	1,468
No of observations	368

Notes:[a] Mean of WTP calculated based on estimated linear-logistic regression. It is E (WTP) = β^0/β^1, Where β^0 is the estimated constant and $\beta^1$is estimated coefficient of bid level.

Source: Author's calculation based on Logit model.

Table 06: Estimated parameters of logistic model

Variables in the equation	β	Std.Error	Wald	Sig	Exp(β)
Bid level (X1)	0.003	0.001	36.265	0.000	1.003
Location of paddy field (X2)	2.573	0.775	11.038	0.001	13.111
Irrigation scarcity (X3)	1.375	0.552	6.209	0.013	3.956
Ownership of paddy land (X4)	1.973	0.677	8.494	0.004	7.190
Main income source (X5)	1.344	0.559	5.778	0.016	3.834
Farm income (X6)	0.001	0.000	6.582	0.010	1.001
Extent cultivated of paddy (X7)	1.171	0.359	10.648	0.001	3.225
Knowledge on water management (X8)	1.186	0.523	5.136	0.023	3.274
Constant (X9)	-15.826	2.193	52.085	0.000	0.000

Note: β = Logistic coefficient, Exp (β) = exponentiated coefficient

Source: Author's computation with sample observations

Table 07: Percentage change in odds- metric variables

Variables	Percentage change in Odds[a]	Exp(β)
Bid level (X1)	0.3	1.003
Farm income (X6)	0.1	1.001
Extent cultivated of paddy (X7)	222.5	3.225
Constant (X9)	0.000	0.000

Note:[a]= e^{b}_{i}- 1*100, Source: Author's calculation

Since all exponentiated coefficients are greater than one, it denotes positive relationship with dependent variable as concluded previously. According to the value of percentage change in odds, a one unit change in extent cultivated area will increase the odds by 222.5 %. It was evident that large scale farmers were extremely committed to paying irrigation water than small scale farmers. A one unit change in net farmer income leads to increase the odds by 0.1%. Thus, farmer income does not mirror much influences on decision of WTP.

Nonmetric independent variables

The exponentiated coefficients are the best means of interpreting the impact of the dummy variable (Joseph *et al*., 2010). Exponentiated coefficient represents the percentage of the odds ratio of farmers who agreed to pay for irrigation compared to disagreed farmers. Because 1 stated for agreed farmers and 0 states disagreed farmers in the model. Thus, summarized nonmetric coefficients are given in Table 08.

Among exponentiated coefficients, locations of the paddy field have been highly associated with the willing to pay decision. Location coefficient is 13.11 means that, tail-end farmers have 1211 percent higher odds than head-end farmers (13.11-1*100). Simply, tail-end farmers are 1211 percent higher enthusiastic for paying on irrigation water than head-end farmers.

This result is also consistent with empirical findings. In Sri Lanka, several studies on water allocation between head-end and tail-end reaches have reported that farmers at the tail-end of the canal receive a disproportionately small amount of irrigation water and at times no water at all (Bhattarai, *et al*., 2006). Therefore, majority of tail-end farmers agreed to pay for irrigation. Second important nonmetric independent variable is ownership of irrigable land. Those farmers who legally owned irrigable land has reflected more commitment for paying irrigation water than others. Farmers who have legal ownership for their irrigable land were at 719% higher odds than others. Further, those who are getting insufficient irrigation water for their paddy land were at 295% higher odds than those who were getting sufficient water for paddy land. This result too indicates the universal fact that the scarcity is the key factor behind the price of a commodity. Even in practice, existing knowledge on irrigation management helps farmers to decide the value of irrigation water. In this case, farmers who have water management knowledge stated 227% higher odds than others. Further, if main income source is farming, such respondents have 283% higher odds than farmers who were not fully employed in farming.

Assessing overall model fit

Likelihood Ratio Test (LRT) has been used to compare two nested models and the results are presented in Table 09. In this exercise, the -2LL value has reduced from the based model value of 342.767 to 119.375, a decrease of 223.392. This increase in model fit was statistically significant at 0.000 levels.

Table 08: Magnitudes of non-metric variables

Variable	Exp(β)
Location of paddy field (X2)	13.111
Irrigation scarcity (X3)	3.956
Ownership of paddy land (X4)	7.190
Main income sources (X5)	3.834
Knowledge of water management (X8)	3.274
Constant (X9)	0.000

Source: Author's calculation

Table 09: Overall model fit

Change in -2LL (-2 Log Likelihood)	Change	Significance
From Base Model	223.392	0.000
From Prior Step	4.514	0.808

Source: Author's calculation based on logistic regression model

Note: Initial -2 Log Likelihood is 342.767 and with final step it is 119.375v

CONCLUSION

The main objective of this paper is to measure the economic value of irrigation water and identify the main factors behind willingness to pay decision. The value of irrigation water under WTP approach is Rs. 5,275($40) per ha per season. These results are close to the finding of Renwik (2000) who valued irrigation water as Rs. 6,699 ($52) per hectare and that of the figure projected by Bandara and Weerahewa (2003) at Rs. 5,727 ($44) per hectare. Further, Sivarajah (2005) stated that the economic value of irrigation water was Rs. 6,300 per hectare per season ($48). However, the proposed charging price is substantially higher than government charged price in the late 90s which was Rs. 200 per/ha/season. (This fee collection scheme was totally collapsed just after five years). Currently Farmer Organizations are collecting membership fees for channels operation and maintenance. Nevertheless, this pricing structure is much lower than what they are willing to pay. Thus, this calculation will benefit the farmer organization to re-structure their pricing policy by implementing better water management practices in large-scale irrigation schemes.

The estimated value of irrigation water is 8.6 percent of net income in paddy farming per hectare at present in selected irrigation scheme. Further, if farmers can increase further their farm income by 5.9%, it is possible to cover additional cost which would be driven due to pricing irrigation water. In fact, it is not an unreachable challenge with proper irrigation service among commend area. According to Shantha (2011a), even at the movement the technical efficiency of large scale irrigation schemes in Sri Lanka is 60.23%. This indicates that there is scope of further increasing the paddy production by 39.77% without increasing the level of input. Thus, it was obvious that the 8.6 percent net income from paddy farming is not a big challenge even at existing water management conditions.

In addition, volumetric pricing of water greatly support to overcome inequitable distribution of irrigation water among head-end and tail-end farmers in large scale irrigation schemes in Sri Lanka. According to Shantha (2011b), overall annual total income disparity between head-enders and tail-enders was 0.6362 (Gini-Coefficient) in a selected large-scale irrigation project in Sri Lanka. Thus, pricing irrigation water is one of main solutions to over utilization of irrigation water by head-end farmers..

A stepwise backward binary multivariate logistic regression model has identified the key factors that influenced the willing to pay decision of respondents. Among those, location of paddy field, water scarcity, existing knowledge of water management, ownership of paddy land, source of main income, extent cultivated and farm income were extremely associated with paying decision of respondents.

It was important to highlight that the tail-end farmers were more devoted than head-end farmers regarding implementation of water pricing policies. These results indicate the universal fact that the degree of scarcity of common pool resources guides to determine the value of such resources. One of most important policy implications of this study is a possibility of restructuring the existing free of charge irrigation system by taking into account the economic value of irrigation water. Such policy reform can encourage farmers to use irrigation resources efficiently by motivating improvement in water management practices and generating revenue for operation, maintenance and capital replacement and irrigation sustainability in the country.

REFERENCES

Bandara, H., & Weerahewa, J. (2003). Economic Value of Irrigation Water in Paddy Cultivation in Sri Lanka. *Tropical Agricuturao Researh, 10*(1), 14-26.

Bandaragoda, D. (1998). *Design and Practice of Water Allocation Rules:Lesson from warabandi in Pakistan,Punjab.* Colombo: International Irrigation Management Institute (IIMI) Research Report.

Barrow, C. (1991). *Land Degragation and Breakdown of Terrestriel Envionments.* Cambridge: Cambride University Press.

Bartlet, J., Kotrlic, J., & Higgins, C. (2001). Organization Research: Determining Appropriate Sample Size in Survey Research. *Information Technology, Learning and Performence journal, 19*(5), 43-50.

Bhattarai, M., Sakthivadival, & Hussain, I. (2006). *Irrigation Impact on Income Inequalities and Poversty.* Colombo: International Water Management Institute (IWMI).

Bos,M.G, Feddes, R., & Vos, J. (1990). Water change and Irrigation Efficiency. *Irrigation and drainage System, 4*(2), 267-278.http://dx.doi.org/10.1007/BF01117746

Cameron, T. (1998). A New Paradigm for Valuating Non-Market goods Using Refrendum Data. *Journal of Environmental Economic and Management, 15*(1), 355-379.

Department of Irrigation. (2012). *Annual Statistics*. Colombo: Planning division, Department of Irrigation.

Gazmuri, S., & Rosegrant, M. (1996). Chilean Water Policy: The Role of the Water Rights, Instiution and Market. *International Journal of Water resourc Development, 12*(1), 33-48. http://dx.doi.org/10.1080/713672192

Gunathilaka, H., Chen, J., Pattanak, S., & Chde, K. (2007). *Good practices for Estimating Reliable williness-to-pay value in the water supply and sanitation sector- ERD technical notes series , No 23.* Phillipines: Asian Development Bank, Economic and Research Department.

Hanemann, W. (1984). Welfare Evaluations in Contingent Valuation Experiments with Discreate Responses. *Americal Journal of Agricultural Economics, 66*(2), 332-41. http://dx.doi.org/10.2307/1240800

Henegedara, G. (2002). Agricultural Policy Reform in the Paddy Setor in Sri Lanka: An Overview. *Sri Lanka Journal of Agriculture, 10*(1), 1-25.

Herath, C., & Gichuki, F. (2006). Willingnes to Pay for Irrigation Water For Paddy Farming: A Case Study in Lunuwewa in Mahaweli System H. *Proceeding of Water Professional Day Symposiam on Water Resources Research in Sri Lanka* (pp. 24-37). Kandy, Sri Lanka: Geo-Informatics, Society of Sri Lanka, University of Peradeniya.

Hussain, I., and Hanjra, M. A. (2004). Irrigation and Poverty Alleviation : Review of The Empirical Evidence. *Irrigation and Drainage, 53*(2), 1-15. http://dx.doi.org/10.1002/ird.114

Hussain, I., Giordano, M., and Munir, H. (2005). *Agricultural Water and Powerty Linkages:Case Studies in Large and Small Systems.* Colombo: International Water Management Institute (IWMI).

International Rice Research Institute (IRRI), (2012). *GAPs fill the Gap.* Manila: International Rice Research Institute.

International Water Management Institute (IWMI), (2005). *Development Strategy for the Irrigation Sector in Sri Lanka 2006-2016.* Colombo: International Irrigation Management Institute.

International Water Management Institute (IWMI),(2002). *Irrigtion Sector in Sri Lanka:Recent Investment Trands and the Development Path Ahead.* Colombo: International Water Management Institure.

Johansson, R. (2000). *Pricing Irrigation Water: A literature Survey.* Washington DC: World Bank. http://dx.doi.org/10.1596/1813-9450-2449

Johnson, S. (1990). Progres and Problem of irrigation Investment in South and Southeast Asia. *Water International, 15*(1), 15-26. http://dx.doi.org/10.1080/02508069008687107

Joseph F, H., Black, W., Barry, J., & Rolph E, A. (2010). *Multivariate Data Analysis (Seventh Edition).* Pearson Prentice Hall.

Petra, H. J., & Perry, C. J. (2006). Can Irrigation water Use Be Guided by Market forces? Theory and Practice. *Water Resurce Development, 22*(1), 79-86. http://dx.doi.org/10.1080/07900620500405643

Renwick, M. (2000). *Valuing water in Irrigated Agriculture and Reservoir Fisheries: A Multiple Use Irrigation System in Sri Lanka.* IWMI Research Report 51 Colombo: International Water Management Institute (IWMI).

Rogers, P., de Silva, R., & Bhatia, R. (2002). Water is an Economic good: how to use prices to promote equity,efficiency and sustainability. *Water policy, 17*(2), 1-17. http://dx.doi.org/10.1016/S1366-7017(02)00004-1

Rosegrant, M., & Ringler, C. (1993). World Food Markets into the 21st Century: Environmental and Resource Constraints and Policies. *Australian Journal of Agricultural and Resource Economics, 41*(3), 401-428. http://dx.doi.org/10.1111/1467-8489.t01-1-00020

Shantha Aruna, A. (2011a). Technical Efficiency in Stochastic Frontier Production Model: A case Study of Irrigated Paddy Farming Under Village Tanks in Sri Lanka. *Eight International Conference on Business Management* (pp. 9-26). Colombo: University of Sri Jayawardanepura.

Shantha Aruna, A. (2011b). The impact of Uneven Allocation of Irrigation Water on Dynamics of Agibusiness & Income Inequality: The Case of Mahaweli Development Project In Sri Lanka. (pp. 148-165). Colombo: University of Sri Jayawardena Pura - Sri Lanka.

Sivarajah, P., & Ahamad, A. (2005). Economic Valuation of Irrigation water under Major Irrigation Scheme (Gal Oya) in Eastern Sri Lanka. *Proceedings of the National Conference on Water, Food security and Climate Change in Sri Lanka* (pp. 89-92). BMICH , Colombo: International Watermanagement Institute (IWMI).

Stewart, B., & Nielsen, D. (1990). Scope and and Objective of Monograph, in Dennis Wichelns (Eds). *Water Resource development, 15*(4), 543-560.

Thiruchelvan, S. (2009). Enhancement of capacity pf Farmer Organization for Sustainable IrrigationSystems in Anuradapura and Kurunegala Districts. *Proceeding of the International Conference on Water, Food Security and Climate Change in Sri lanka* (pp. 7-15). BMICH- Colombo: International Water Management Institute (IWMI).

Upasena, W., & Abegunawardna, P. (1993). Economic Value of Irrigation Water in Dewahuwa Irigation Scheme. *Tropical Agricutural Research, 5*(2), 181-193.

Wedgwood, A., & Sansom, K. (2003). *Willing-to-Pay Surveys: Streamlined Approach.* Loughborough University. U.K: Water Engineering & Development Centre.

Wegerich, K. (2007). A Critical Review of the Concept of Equity to Support Water Allocation at Various scales in the Amu Darya Basin. *Irrigation Drainage Syst., 21*(1), 185-195. http://dx.doi.org/10.1007/s10795-007-9035-1

Whittington, D., McClelland, E., & Davis, J. (1998). Implementing and Demand Driven Approach to Comunity Water Supply Planning. *Water International, 23*(1), 134-145. http://dx.doi.org/10.1080/02508069808686760

Wichelns, D. (1999). Economic Efficiency and Irrigation Water Policy with an Example from Egypt. *Water Resourc development, 15*(4), 543-560. http://dx.doi.org/10.1080/07900629948754

Zhag, X., Chen, S., Pei, H., & Wang, Y. (2008). Dry Matter, Grain Yield and Water Use efficiency as Affected by Water Supply in Winter Wheat. *irrigation Science, 27*(2), 1-10.