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Impact of External Costs and Benefits of Paddy Farming in Sri Lanka

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Abstract: **The objective of this paper is to conduct a comprehensive analysis of costs and benefits of paddy production with special reference in externalities. As negative effects, human health problem and human and animal poisoning and as positive social effect flood mitigation, recharge groundwater, purification of water and increasing highland crop(s) yields are evaluated in this study. According to the analysis, considering direct costs and benefits, it is concluded that Paddy farming in Sri Lanka is a profitable farming industry. The total external benefit (TEB) was higher than the total external cost (TEC) in any scheme. In terms of that total social benefits (TSB) was also higher than the total social cost (TSC) in any scheme. These results suggested that the paddy farming process in Sri Lanka released benefits to the society than costs. Therefore, it is indicated that the social required quantity is higher than the current equilibrium quantity. Further, it is concluded that major irrigated paddy farming has plenty of opportunities to implement new projects in order to maximize the benefits of paddy farming.**

Keywords: **costs benefits analysis, externalities, paddy production, social benefits, social cost.**

I. INTRODUCTION

Sri Lanka's rice sector alone contributes 10.8 per cent to the agricultural GDP which accounts for 1.6 Percentage of GDP in the year 2013 (CBSL, 2014). The value of annual rice production is approximately 4.62 million metric tons at present which is at an increasing trend (CBSL, 2014). There are 879,000 farm families which comprise 20 Percentage of the total population. Thirty two Percentage of the total labor force is directly engaged in the rice sector (DOASL, 2008). Sri Lanka has 730,000 ha of prepared lands suitable for paddy cultivation at present. Out of this on the average of 560,000 ha are being cultivated during Maha[1] season which represents for a seasonal cropping intensity of 76.7 and 310.000 ha in Yala season that equals to seasonal cropping intensity of 42.4 per cent. During the Maha Season, 752,442 acres under major irrigation, 393,293 acres under minor irrigation and 443,908 acres under rain fed and during the Yala season 465824 acres under major irrigation, 182,354 acres under minor irrigation and 186,065 acres under rain fed, are cultivated and harvested in the year 2009 (DCSSL, 2012).

With the development of paddy cultivation sector in Sri Lanka, the use of chemicals, machinery and improved seeds have been increased since the farmers are mainly concerned about the private costs and benefits that they have to incur to achieve desirable outputs and least concerned about the undesirable byproducts of their production processes (Nishantha, 2014). According to Herath (1984), salinity level of Mahaveli H area in Sri Lanka, greater than 4.5 mmhos/cm and rise yields could thus be affected. Further, there was a 10 Percentage reduction in rice yield in this area than in non-salinity area. Bandara and Coxhead (1999) reveal that up and mid country agricultural land erodes at an average rate of 14.5 tons per hectare per year in Sri Lanka. Central Bank of Sri Lanka (CBSL) (2011) figured out that the fertilizer issues in paddy sector have been increasing rapidly. According to the CBSL (2004), in the year of 2000, the total of fertilizer issues in paddy sector was 262,362 Kg which number has approximately doubled within 9 years. In the year of 2009, total of fertilizer issue in paddy sector was 422,968 Kg. According to FAO (1998) Sri Lanka ranks very high in the Asia Pacific Region with regard to pesticide related health hazards and annually, the total number of pesticide accidents in Sri Lanka is around 20,000.

[1] There are two main paddy cultivating seasons in Sri Lanka known as Yala and Maha

In the literature of agricultural research, there is a substantial amount of many studies that considered externalities of agricultural production and many of those have estimated monetary values of externalities of agriculture production. In accordance with Atwood (1994) and Clark et. al. (1985), Industrial agriculture is increasingly being recognized for its negative consequences on the environment, public health, rural communities, soil loss and erosion, reduced crop yields and impair meant of natural and man-made water systems. Not only negative external effects but also positive external effects are produced by the paddy farming activities. Flood mitigation, fostering water resources, preventing soil erosion, purifying water, cooling air temperature, refreshing atmosphere and recreation are some positive external effects that are generated by paddy production.

In the Sri Lankan context, Bandara et. al. (2001) was found that soil erosion imposes substantial economic costs in Sri Lanka and there has been a concern that policy reforms such as trade liberalization may aggravate this problem. Mateus (1983) stated that while consumers' surplus in the food stamp rice market increased and producers' surplus was not affected, treasury costs have been very small compared to the increase in consumer surplus. But both Gunawardana (1987) and Mateus (1983) did not consider about externalities which were arisen by paddy farming process. However the effect of externalities of paddy farming has not been clearly highlighted and not been estimated in the field of agriculture in Sri Lanka.

As other agricultural practices, paddy cultivation also generates positive externalities as well as the negative externalities. Since the activities of paddy farming are multi-functional, many external benefits can be found. Therefore, when costs and benefits are estimated, not only in terms of direct costs and benefits but also external costs and benefits of paddy farming should be taken into account. As explained earlier paddy cultivation in Sri Lanka has gradually increased during the past few decades and the use of fertilizers and other agro-chemicals, machinery etc. also have gradually increased. Consequently, generating both negative and positive externalities of paddy farming sector has been increasing ever than before. Mostly farmers concentrate only on private costs and benefits and they do not care about the social effects of their paddy farming practices. Although, at the micro level, paddy cultivation is desirable when the net private benefits are positive, at the macro level it is economically and as well as socially desirable only if the social benefits are greater than social costs; in other words only if the net social effect is positive.

Hence, this study focused to estimate costs and benefits of paddy production process considering negative and positive externalities and estimating the monetary value of both negative and positive effects using newly derived formula under the guidance of several non-market valuation methods. The result of the study will be useful for decision making in agricultural sector to construct appropriate policies for the paddy sector in Sri Lanka and it will make a positive way to carry out new researches on paddy production process.

II. METHODOLOGY

The objective was accomplished using both primary and secondary data. Primary data was collected using structured interview method and experiment method. Hundred and fifty (150) sample units were selected as a sample for the interview from the three schemes of paddy cultivation namely major irrigation minor irrigation and rain-fed by using the method of two-stage stratified sampling. Eighty paddy farmers in major irrigated scheme, fifty paddy farmers in minor irrigated scheme and twenty paddy farmers in rain-fed scheme were selected according to standard deviation of distribution of individual extent paddy land, margin of error and specific confidence level. There were 30 measurement points from each scheme for the experiment was selected by dividing paddy field to three clusters according to the surface elevation. Then ten Points were randomly selected from the each cluster.

The monetary value estimation of its negative and positive effects were obtained using the mathematical formulas which were formularized based on non-market evaluation methods of cost of illness and lost output approaches, contingent valuation, benefit transfer and replacement cost.

To analyze the data bivariate analysis has been carried out through regression analysis, and ANOVA .The regression analysis was utilized to derive the functions of TPC=f(Q), TR=f(Q), TEC=f(Q), TEB=f(Q), TSC=f(Q),TSB=f(Q). Those models were estimated using Ordinary Least Square (OLS) method. ANOVA was adopted to determine the mean differences of specific scale variables within the schemes of paddy cultivation.

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Variables:

To accomplish the objectives of the study, data for the relevant variables were collected. Variables which are to be applied to recognize the specific production externalities of paddy farming and estimate the direct and external costs and benefits of paddy farming in separate three schemes of cultivation. In estimating the direct cost of paddy farming, the variables such as material cost and machine and labour for land preparation, harvesting, threshing and winnowing were considered. The variables of total quantity of paddy yield, selling price (per Kilogram) and quantity sold were considered to measure the direct benefit of paddy farming. In addition to the above, in order to identify the demographic characteristics of the study area, a set of relevant data were collected under the variables of age, education and occupation both head of household and other family members etc.

Human health problems, animal and human poisoning are the main negative externalities which are considered in this study. Cost of kidney diseases and tooth diseases are the factors which indicate the monetary value of human health problems associate with the paddy farming because kidney and tooth diseases have been spreading significantly in the paddy farming belt in Sri Lanka (Bandara et.al, 2007; Chandrajith et.al, 2010, Centre for Science and Environment, 2012; Nishantha, 2014). Hence, the monetary value of heath problem due to paddy farming was calculated by considering the variables of treatment cost of tooth and kidney diseases, duration of diseases, hospitalized & clinic attended days due to both kidney & tooth diseases and average income per day of individuals in the particular areas. Human and animal poisoning is common in agricultural practices (Khan et.al, 2002). The loss of man days and the expenses of medical treatment lost wealth and assets of peoples due to animal poisoning as well as human poisoning. Hence, the variables of treatment cost of individual human and animals, monetary value of lost humans and animals, number of man days losses and average income per day of individuals are considered in estimating the monetary value of human and animal poisoning due to paddy farming practices in this study.

The empirical studies have revealed that people are benefited by paddy farming practices (Kim et. al], 2006; Matsuno et.al, 2005; Yoshida, 2001; Tsai, 1993). Mitigating floods, recharging and purifying groundwater and increasing highland crop yields are considered as positive externalities of paddy farming in this study. TABLE 1 shows the variables which are applied to estimate the monetary value of above mentioned positive externalities of paddy farming. Further, above mentioned variables are explored for the purpose of recognizing the behavior of external benefits and the sources of external positive effects of paddy farming process.

III. RESULTS AND DISCUSSION

Net social effect of paddy farming:

The purpose of this part is to determine the influence of production externalities of paddy farming considering human health problem and human and animal poisoning as the negative external effects and flood mitigation function, purification of water, recharge groundwater and increased highland crop(s) as the positive external effects. Based on experiment and survey data calculated monetary values of total external costs (TEC), total external Benefits (TEB), total social costs (TSC) and total social benefits and net social effects in paddy production per acre given in TABLE 2

Considering the data in the TABLE 2, it is indicated that the value of TEC, TEB, TSC and TSB are differ within schemes. Further, ANOVA proved that those variations within cultivation schemes are statistically significant. Thus, it is concluded there is a considerable difference of external costs and benefits of paddy farming within the schemes of cultivation.

It is observed that TEB is higher than TEC in all schemes. Following that TSB is also higher than TSC in all schemes. These results suggest that when paddy farming in Sri Lanka produces benefits to the society than costs. It indicates that the social required quantity is higher than the current equilibrium quantity. Therefore, government should distribute more subsidies to the paddy farmers to maintain the social requirement.

Private cost and revenue functions:

Regression models of 1, 2 and 3 are the total production cost (TPC) functions of paddy production in major irrigation scheme, minor irrigation scheme and rain-fed scheme respectively. In those models dependent variable is the total private costs (TPC) of paddy farming which is represented by TPC_{mr} for major irrigation scheme, TPC_{mn} for minor irrigation scheme and TPC_{rfd} for rain-fed scheme. The independent variable is paddy yield which is represented by Q.

$$TPC_{mr} = 202.585Q^{0.679} \qquad \ldots 1$$

$$TPC_{mn} = 61.197Q^{0.781} \qquad \ldots 2$$

$$TPC_{rfd} = 1292.153Q^{0.401} \qquad \ldots 3$$

It is observed that production cost elasticity ($E_{pc)}$ of quantity (paddy production) is 0.679 in Major irrigation scheme, 0.781 in minor irrigation scheme and 0.401 in rain-fed scheme. These values indicate that the sensitivity of total cost of paddy production for changing quantity 67.9 per cent in major irrigation scheme, 78.1per cent in minor irrigation scheme and 40.1per cent rain-fed scheme. Further, it shows that ΔTPC % < ΔQ % in all three schemes. However elasticity of cost of paddy production in minor irrigation scheme is relatively higher than the elasticity of cost in major irrigation scheme and rain-fed scheme. It is suggested that efficiency of costs (Inputs) of production in minor irrigation scheme is lower than major irrigation scheme and rain-fed scheme. In practice, since insufficient water supply of paddy farming in minor irrigation scheme, becomes low an, it is unable to reach to the expected production by applying more inputs.

Following models of 4, 5 and 6 are the total revenue (TR) functions respectively in major irrigation, minor irrigation and rain-fed schemes. Those models explain how TR of paddy farming is changed by the paddy yield (Q). Then the total revenue of paddy farming is the dependent variable which is represented by TR_{mr}, TR_{mn}, and TR_{rfd} respectively in major irrigated, minor irrigated and rain-fed scheme.

$$TR_{mr} = 16.96Q^{1.026} \qquad \ldots (4)$$

$$TR_{mn} = 44.637Q^{0.87} \qquad \ldots (5)$$

$$TR_{rfd} = 390.19Q^{0.563} \qquad \ldots (6)$$

In view of the revenue elasticity (E_R) of production in paddy farming, it is observed that if quantity of paddy production is increased by 1 per cent then revenue increases by 1.026 per cent in major irrigation scheme. This result indicates that marginal revenue is increased by the increasing production. Based on this, it is concluded that there is a significant possibility to increase paddy production in major irrigation scheme. Further, it is concluded that the market price is increased when paddy production increases in major irrigation scheme. Since, most of individual paddy lands under this scheme are larger than 2.5 acres, and then most of farmers get relatively high quantity of harvest. This implies that paddy farmers in major irrigated scheme can slightly influence on the market price of paddy. In the minor irrigation scheme, when quantity of paddy production is increased by 1 per cent, revenue is increased by 0.87 per cent. When quantity of paddy production is increased by 1 per cent, revenue is increased by 0.563 per cent in the rain-fed scheme. These results indicate marginal revenue is decreased by increasing production in both minor and rain-fed scheme. In both schemes the individual paddy land size is relatively small. Therefore, individual quantity of harvest is not enough to control the paddy market. Hence, the paddy farmers sell their harvests for current market price in minor irrigated and rain-fed schemes. In practice, in the harvesting period, market price of paddy is getting down. Therefore, paddy farmers in minor irrigated and rain-fed scheme have to sell their harvests at lower rates. Based on this, though some farmers have a possibility to cultivate more land, they do not do it most probably. In practice, the farmers how have more cultivable paddy lands they tend to farm out their paddy lands to several others.

Further, comparing TPC function and TR function separately for each scheme, it is indicated that elasticity of revenue (E_R) and elasticity of production cost (E_{PC}) differ within schemes. It is concluded that the scale of paddy production process influences to change the sensitivity of cost and benefit on quantity. In addition to that E_R is higher than E_{PC} for all schemes. Hence, it is concluded that paddy farming in Sri Lanka is still profitable farming industry under the condition production externalities are not considered. This conclusion can be further verified by studying the behavior of marginal functions of TPC and TR (see figure 1).

In Fig. 1, marginal revenue (MR) and marginal cost (MC) curves are obtained by the derivative functions of TR and TPC functions which are given above. It shows the difference between MR and MC which indicates the marginal profit of each scheme. Considering the marginal profit respectively in three schemes it is observed that marginal profit of major irrigated paddy farming is higher than other two schemes. MC is decreased and MR is increased by expanding production significantly in this scheme. Even though, minor irrigation scheme and rain-fed scheme also indicate positive marginal profits, MC and MR curves distribute in parallel. Thus it is concluded that marginal profit is not expanded by expanding production in minor irrigated paddy farming and rain-fed paddy farming. Considering the current situation of these three cultivation schemes, major irrigation scheme has sufficient water for expanding paddy farming. Although the other two schemes have enough lands, they do not have an adequacy to fulfill the water requirements for expanding paddy farming. This analysis suggests that the paddy farming under Major irrigation id profitable and economically efficient than other two schemes. However, there is no possibility to expand the paddy land in major irrigation scheme further. Therefore, policy makers should concentrate on the relevant policies that lead to increases the productivity of paddy farming in major irrigated scheme.

External costs and benefits functions:

The regression models 7 and 8 tell that how external cost of paddy farming depend on quantity of paddy production respectively in major and minor irrigation schemes. Then the TEC_{mr} represents the total external costs in major irrigated scheme and TEC_{mn} is the total external costs in minor irrigation scheme.

$$TEC_{mr} = 23.61Q^{0.927} \quad \text{...} \quad (5.7)$$

$$\mathrm{TEC}_{\mathrm{mn}} = 26.87Q^{.0923} \quad \text{...} \quad (5.8)$$

According to the model 7, external cost elasticity of quantity of paddy production is 0.927. This value indicates the sensitivity of external cost of paddy production for changing the quantity of paddy production. Accordingly, when the quantity of paddy production is increased by 1 per cent the external cost is increased by 0.927 per cent. The regression model 8 shows that the external cost elasticity of quantity of paddy production in minor irrigated scheme is 0.923, which means that if quantity of paddy production is increased by 1 per cent then external cost increased by 0.923 per cent. When composed these figures, it can be observed that the rate of arising external cost through paddy farming in major irrigation scheme is higher than the external costs paddy farming under minor irrigation schemes. These findings prove that the scale of paddy production process influences to change the sensitivity of cost and benefit on quantity. Since the external costs is arisen due to the impact of health and poisoning of human and livestock, higher external costs in major irrigated scheme suggests that the risk on human health and poisoning human and livestock due to producing paddy is relatively high in major irrigation scheme.

The regression models 9, 10 and 11 illustrates as to how external benefits of paddy farming depend on quantity of paddy production respectively major irrigation minor irrigation and rain-fed schemes. Then the total external benefits of paddy farming is the dependent variable which is represented by TEB_{mr}, TEB_{mn}, and TEB_{rfd} respectively in major irrigated, minor irrigated and rain-fed scheme.

$$TEB_{mr} = 161.282Q^{0.927} \quad \text{...} \quad (9)$$

$$TEB_{mn} = 74.176Q^{0.923} \quad \text{...} (10)$$

$$TEB_{rfd} = 455.392Q^{0.635} \; . \; \text{...} (11)$$

According to the model 9, external benefits elasticity of quantity of paddy farming is 0.927 in major irrigation scheme. This value indicates the sensitivity of external benefits of paddy production for changing quantity of production in major irrigated scheme. According to the estimated coefficient, when quantity of paddy production is increased by 1 per cent, external benefits increases by 0.927 per cent. Similarly, model 10 shows that the external benefit elasticity of quantity is 0.923, which means that when quantity of paddy production is increased by 1 per cent, external benefits in minor irrigation scheme increases by 0.923 per cent. According to the regression model 11, the external benefit elasticity of quantity in rain-fed scheme is 0.923, which means that when quantity of production is increased by 1 per cent, external benefits increases by 0.635 per cent in rain-fed scheme. The result confirmed that the scale of paddy production process influences to change the sensitivity of cost and benefit on quantity. Further although ΔTEB % >ΔQ % for all three schemes, the rate of arising external benefits through paddy farming in major irrigation scheme is higher than in other two schemes.

As shown in fig. 2, the marginal external benefits (MEB) curves distribute in over the marginal external costs (MEC) curves in both schemes. Thus, it is concluded that since external benefits are born by external parties, higher positive net social effects of paddy farming suggest that external parties enjoy considerable benefits from paddy farming.

Social costs and benefits functions:

The regression models 12 and 13 TSC_{mr} represents the total social costs in major irrigated scheme and TSC_{mn} is the total social costs in minor irrigation scheme. Quantity of paddy yield is the independent variable which is represented by Q. TSC function for rain-fed scheme is same as TPC function because this study couldn't find the any significant source of negative effects in rain-fed paddy farming process.

$$TSC_{mr} = 153.87Q^{0.791} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (12)$$

$$TSC_{mn} = 76.742Q^{0.862} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (13)$$

Though both private and external costs in major irrigated paddy farming is higher than in minor irrigated paddy farming, it is observed that social cost elasticity of production in minor irrigated paddy farming is higher than the major irrigation scheme. According to the social costs functions, when quantity of paddy production is increased by 1 per cent, social costs increase by 0.791 per cent and 0.862 per cent respectively in major and minor irrigated schemes. In minor irrigated paddy farming, average individual land size is relatively small and production efficiency of land is also lower than in major irrigation scheme. This may be the possible reason for higher sensitivity of social cost on quantity of production in minor irrigated paddy farming comparing with major irrigation scheme. The regression models 14, 15 and 16 tell that how social benefits of paddy farming depend on quantity of paddy production respectively in major irrigated minor irrigated and rain-fed schemes.

$$TSB_{mr} = 173.319Q^{0.945} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (14)$$

$$TSB_{mn} = 120.560Q^{0.906} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (15)$$

$$TSB_{rfd} = 1014.61Q^{0.582} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (16)$$

The figures reveal that the social benefit elasticity of production in major irrigated paddy farming is relatively higher than the other two schemes. According to above three social benefits functions, when quantity of paddy production is increased by 1 per cent then social benefits is increased by 0.945 per cent and 0.906 per cent respectively in major irrigated and minor irrigation schemes and by 0.582 per cent in rain-fed scheme. Then it is concluded that the scale of paddy production process influences to change the sensitivity of cost and benefit on quantity. These results reveal that major irrigated paddy farming produces benefits to the society than other schemes and magnitude effects of social benefits depend on scale of farming.

Fig. 3 provides the graphical distribution of marginal social benefits (MSB) and marginal social costs (MSC) functions of paddy farming in each scheme separately. MC function is considered as MSC in rain-fed scheme. Fig. 3 reveals that the net social effect of paddy farming is positive in all three schemes. In addition to that, it is observed the MSB and MSC curves are distributed parallel from certain points of production. The highest gap between MSB and MSC is recorded in major irrigation scheme. This means that net marginal social benefits is higher in major irrigated scheme. Net social benefit in rain-fed scheme is indicated as the lowest and in minor irrigated scheme is in between. These results may suggest that the paddy farming in all three schemes is under production. However, considering the aptitude of expanding production of three schemes, it is observed that there are no sufficient inputs such as water and lands in minor irrigated paddy farming and rain-fed paddy farming. Conversely, major irrigated paddy farming has relatively highest potential to expand the production capacity than other two schemes. Finally, it is concluded that major irrigated paddy farming has plenty of opportunities to implement new strategies in order to maximize the productivity and efficiency.

IV. CONCLUSION

It is concluded that Paddy farming in Sri Lanka is a profitable farming industry. The TEB was higher than TEC in any scheme. In terms of that TSB was also higher than TSC in any scheme. These results suggested that the paddy farming process in Sri Lanka released benefits to the society than costs. Therefore, it is indicated that the social required quantity is higher than the current equilibrium quantity. Further, it is concluded that major irrigated paddy farming has plenty of opportunities to implement new projects in order to maximize the benefits of paddy farming.

REFERENCES

[1] Atwood, J. (1994) RCA reservoir sediment data reports 1-5, Washington DC: Soil Conservation Service

[2] Bandara JM, Senevirathna DM, Dasanayake DM, Herath V, Bandara JM, Abeysekara T, Rajapaksha KH (2008) Chronic renal failure among farm families in cascade irrigation systems in Sri Lanka associated with elevated dietary cadmium levels in rice and freshwater fish (Tilapia), Environ Geochem Health., (5), 465-78

[3] Bandara, J.S., Chisholm, A., Ekanayake, A., Jayasuriya, S. (2001) Environmental cost of soil erosion in Sri Lanka: tax/subsidy policy options, Environmental Modelling and Software, Vol. 16, Issue: 6 P. 497-508

[4] Central Bank of Sri Lanka,(2004) Annual report 2003, Central Bank of Sri Lanka, M.D. Gunasena pvt. Ltd., Colombo

[5] Central Bank of Sri Lanka,(2014) Annual report 2013, Central Bank of Sri Lanka, M.D. Gunasena pvt. Ltd., Colombo

[6] Central Bank of Sri Lanka,(2011) Annual report 2010, Central Bank of Sri Lanka, M.D. Gunasena pvt. Ltd., Colombo

[7] Centre for science and environment (2012) Environmental contamination and its association with Chronic Kidney Disease of Unknown Etiology in North Central Region of Sri Lanka, (WWW) Centre for Science and Environment, retrieved from http://www.cseindia.org/userfiles/sri_lanka_final_report.pdf, Accessed (01/05/2014)

[8] Chandrajith R, Nanayakkara S, Itai K, Aturaliya TN, Dissanayake CB, Abeysekera T, Harada K, Watanabe T, Koizumi A. (2011) Chronic kidney diseases of uncertain etiology (CKDue) in Sri Lanka: geographic distribution and environmental implications, Environ Geochem Health. 33(3), 267-78.

[9] Clark, E.H., Haverkamp, J.A. and Champan, W. (1995) Eroding soils: The off farm impacts, Washington DC: Conservation Foundation.

[10] DCSSL (2012) paddy statistics, (WWW), DCSSL, Retrieved from http://ww w.statistics.gov.lk/agriculture/ Paddy%20Statistics/PaddyStats.htm (Accessed 15/03/2013)

[11] DOASL (2006) Water stress effects, water management systems & irrigation requirements for rice in Sri Lanka (WWW), DOASL, Retrieved from http://www.agridept.gov.lk/index.php/en/crop-recommendations/905 (Accessed 01/3/2011)

[12] DOASL (2008) "Apiwawamu Ratanagamu" Paddy sector development in Sri Lanka 2008-2010,(WWW) Department of Agriculture, Sri Lanka, Retrieved from http://www.agridept.gov.lk/content/admin/pdf/Rice.pdf , (Accessed 30/8/2011)

[13] F.A.O. (1998) World Agriculture towards 2000, Belhaven Press, London

[14] Gunawardana, P.J. (1987), Rice pricing and marketing policies in Sri Lanka 1952-1984, Unpublished MSc thesis, La Trobe University, Melbourne.

[15] Khan, M. A., Muhammad, I., Ahmad, I., and Manzoor, S. (2002) Economic evaluation of pesticide use externalities in the cotton zones of Punjab, Pakistan, Pakistan development review, part II ,pp. 683-698

[16] Kim, T.C, Gim, U.S., Kim J.S., and Kim, S.K. (2006) The multi-functionality of paddy farming in Korea, paddy and water Environment, Vol 4, No. 4, pp 169-179

[17] Mateus, A. (1983) Targeting food subsidies for the needy: the use of cost benefit analysis and institutional design, World Bank staff working paper, no 617, Washington D.C., World Bank.

[18] Matsuno, Y., Nakamura,K., Masumoto., T., Matsui, H., Kato, T., Sato, Y. (2005) Multi-functionality of Paddy Rice Cultivation, Review and Future Prospects for Japan and Other Monsoon Asian Countries, In Proceedings of PAWEES Conference in Tokyo

[19] Nishantha, B M N (2014) Influence of Paddy Farming Behavior on Human Health in Sri Lanka, International Journal of Multidisciplinary Thought 04: 02. 267-275.

[20] Tsai (1993) The Public Benefit Externality of Taiwanese Paddy Rice, COA Report, Taipei, Taiwan.

[21] Yoshida, K. (2001) An Economic Evaluation of the Multifunctional Roles of Agriculture and Rural Areas in Japan (WWW) FFTC Publication, Retrieved from http://www.agnet.org/library/tb/154/ (Accessed 12/10/ 2013)

APPENDIX

TABLE 1: The variables for monetary value estimation of positive externalities

Main variable	Sub variable(s)
Monetary value of flood mitigation	Potential amount of water in the individual paddy field
	Annual maintenance cost of storing one cubic meter of water
Monetary value purification of water	Infiltration rate per day
	Number of days of water filled in the paddy field
	Cost of water purification (m^3)
Recharge groundwater	Willingness to pay for water
	Infiltration rate per day
	Number of days of water filled in the paddy field
Effect on highland crops	Yield gap between peripheral area and out of peripheral area

TABLE 2: TEC, TEB, TSC and TSB of Paddy Production per Acre

Scheme	TEC	TEB	TSC	TSB	Net Social Effect
Major irrigated	25240.8	172421.8	55500.69	228783.97	173283.28
Minor irrigated	22937.62	63320.7	46410.01	103968.65	57558.64
Rain-fed	_	32996.66	30497.32	63493.98	32996.66

Source: Calculated Data from Experiment and survey data, 2014

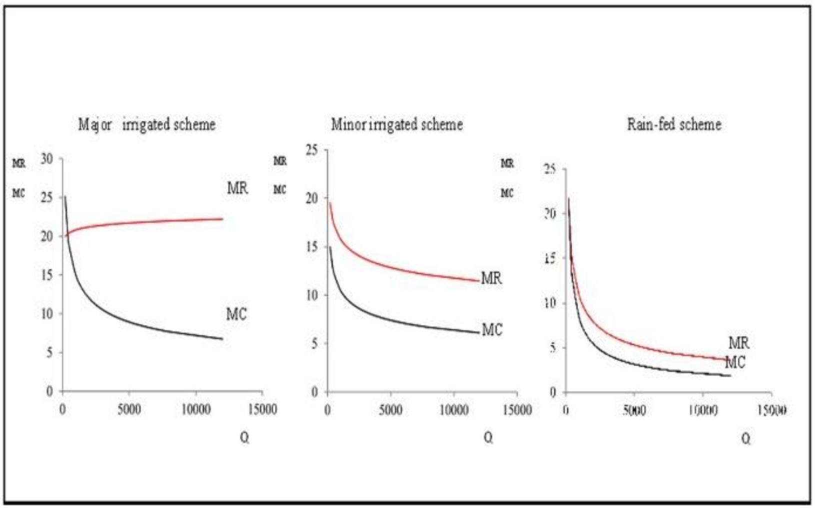

Fig. 1: Behavior of marginal cost and marginal revenue of paddy production by cultivation schemes

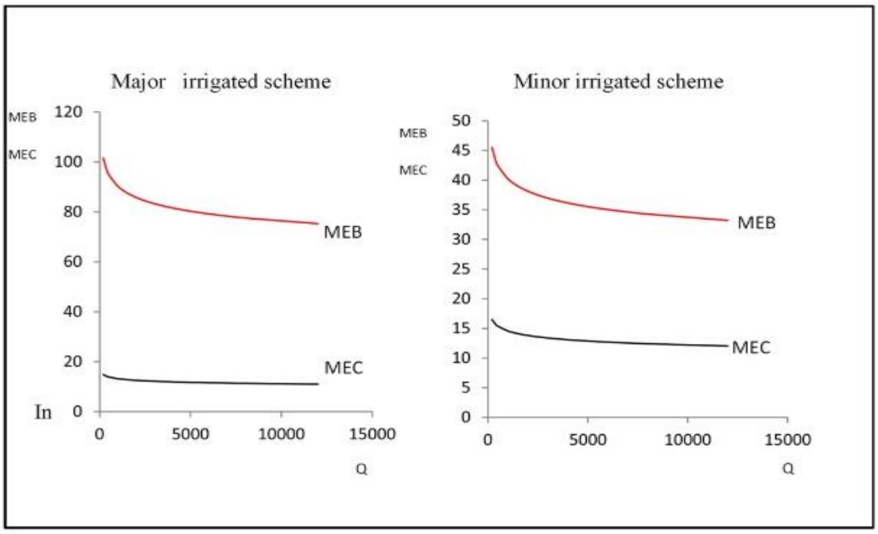

Fig. 2: Behavior of marginal external cost and marginal external benefits of paddy production by cultivation schemes

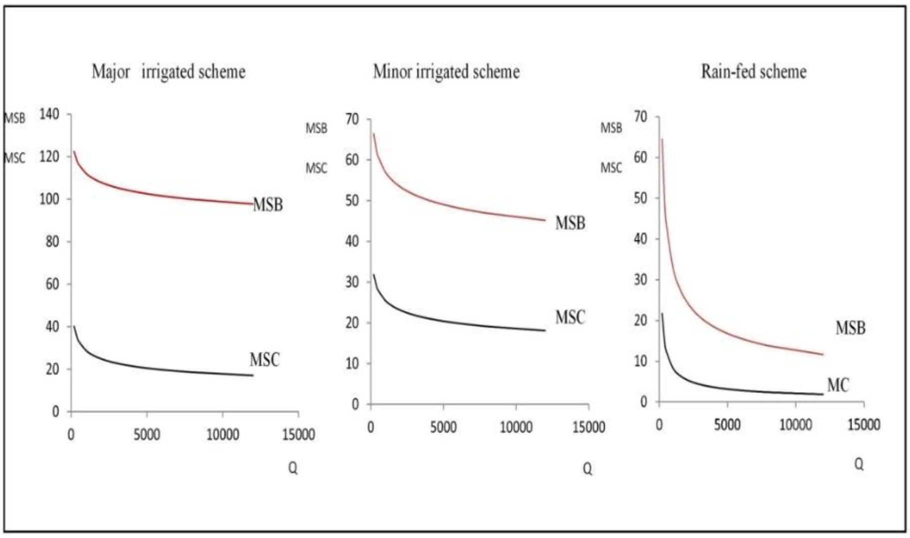

Fig. 3: behavior of marginal social cost and marginal social benefits of paddy production by cultivation schemes