Economic valuation on water and property rights using direct marked approach

Tshering Dendup

Abstract

Since farmers lack the knowledge on how environmental factor like water and socioeconomic factor like property right affect their rice production in terms of a monitory value, valuation of water and property rights is practiced in this paper using direct market approach where values can be obtained using the price of rice sold in the market. In association to the valuation, effect to the rice production when both environmental and socioeconomic factor (water and property right respectively) mixed together is also seen in this paper as no one has done research over this topic. In this paper, there are four objectives; to estimate the association between water and rice yield, to estimate the association between property right and rice yield, to evaluate if the effect of water discharge is heterogeneous between different property rights and to find the economic value of water and property rights. When we estimate the association between water and rice yield, as water volume changes from low to high the rice yield per decimal increases by 4.088 kg. When it estimates between the rice yield and property right, when property rights changes from private to sharecropper, rice yield per decimal increases by 7.66 kg. When we see the interaction's impact on the rice yield, a sharecropper with high water volume collects more rice yield compare to those private owners with low water volume. In the fulfilment of our final objective, the actual value of water is seen Nu. 413.95 and the actual value of property right is seen Nu. 775.65. This value can be used to see how much of money does farmer bears the loses or gains the profit due to the alteration of environmental factor like water and socioeconomic factor like property right.

Key Terms: Environmental factor, property right, private owner, socioeconomic factor, sharecropper, valuation, water, water discharge

Introduction

All the living creature in the planet earth enjoys goods and services that is being provided by ecosystem and biodiversity but we are technically unfamiliar to those good and services. Due to the unfamiliarity towards the good and services that ecosystem and biodiversity provides, our understanding towards those services is not clear. The understanding of how these services affects the wellbeing of people who avails the services will still be not clear since the total value of those impacts are not seen in a concrete thing. People who practices agricultural activities never know how their products are being affected due to the alteration of environmental factors and other related factors which will indirectly affects their economy as well as their wellbeing (Hanley and Spash, 1993).

The 2030 Agenda for Sustainable Development Goals (SDGs), and the Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC) has both the framework and the targets that should guide every individual towards having an inclusive growth and sustainable livelihoods. In the attainment of these targets, agriculture plays a major role through its link to food security and agriculture production in return is affected by various environmental factors like water and socio-economic factors like property rights. A clear understanding on the impacts due to those factors must be known perfectly by every farmers so that the agricultural production can be kept in control in every hand of a farmer and increase the productivity to achieve the targets. In order to have a clear understanding of their impact on the production, valuation on those factors are must to do (FAO, 2017).

Valuation can be defined as an effort to put monetary values or to environmental goods and services or natural resources. It is a main exercise in economic analysis and its results provide significant information about values of environmental goods and services. This information can be used to influence decisions about sensible use and preservation of the ecosystems and other environmental goods. The basic aim of valuation is to regulate people's preferences by assessing how much they are willing to pay for given benefits or certain environmental attributes. In other words, valuation also tries to measure how much worse off they would consider themselves to be as a result of fluctuations in the state of the environment such as degradation of a forest. Economic valuation never mentions to a stock, but only the alteration in a stock. If one states of the economic value of biodiversity, then one always means the economic value of an alteration of biodiversity. It is not a question of determining the accurate value of biodiversity or ecosystems but valuing changes and comparing them with their alternatives.

In most of Asia, rice is not only the main food, but also creates the major economic activity and a main source of employment and income for the rural population. Water is the single most significant factor for sustainable rice production, especially in the traditional rice growing areas of the Region. Due to the climate change, the pattern of rainfall gets disturbed and the accessibility of water to the individual farmer especially in arid region for the paddy cultivation becomes limited and have to bear so much of losses. Reduced investments in irrigation infrastructure (water), increased race for water and the accessibility of water to farmers to cultivate paddy is inadequate thus lowering the sustainability of rice production.

Like water factor, property rights of individual famer also affects their rice productivity where farmer who gives their land into lease will have low rice yield and those who takes land under lease produces more rice. Lease giver (private owner) with self-sufficiency goal in their mind, they don't put effort in producing more rice yield whereas farmer who took lands under lease would be pressurize by the high rental prices which leads to the putting more effort in cultivating more paddy and results in producing more rice yield (Koirala, Mishra, & Mohanty, 2014).

Since water factor and the property rights has an impact on the productivity of rice, in order to educate the farmers on the impacts in terms of monetary value, the valuation of water and property rights is practiced in this paper using direct market-based method, where the values can be obtained directly using the rice price sold in the market by the farmers. In association to the valuation, impact on the rice yield when both water and property rights mixed together is also seen.

Literature Review

Valuation support efficient as well as equitable allocation, assist the process of proper distribution, and provides means of attaining better optimality in social consumption and production. Valuation minimizes the scope for market failures and enhances its creation. Sometimes, there are goods for which markets do not exist. Examples are certain environmental resources, which are apparently abundant in nature, e.g. air, water, and so on. Because of non-existent markets, there is no market-clearing price (Hori, & Sakajiri, n.d.).

The most significant part of water valuation is in demand management and better distribution among its numerous uses. Enhanced water resource management requires decisions based on economic efficiency, social equity, and ecological sustainability. Because of water's exclusive characteristics and socio-cultural importance, attempts to monetarily value water services is both problematic and inappropriate. Yet, economic valuation (the process of attaching a monetary metric to water services) is an increasingly significant tool for policy-makers and planners faced with difficult decisions regarding the distribution and improvement of freshwater resources. With market prices not capable to capture the full scale of their costs and benefits, economists have established different techniques to estimate water's non-market values. Two important cases when these tools are employed are during tariff-setting and assessments of alternative government strategies. Understanding the value of water is important if the limited resource is to be more effectively and efficiently used to meet societal needs (United Nations Educational, 2017).

Under water valuation, there are many methods to value the water. Some of these methods were, volumetric which is a measure of the volume of water consumed from an irrigation system (Ghosh & Bandhyopadhyay, 2009), non-volumetric method where it is used in situations when volumetric pricing is either unfeasible or undesirable, market-based method where it is used to reduce the inefficiencies in water allocation(Windows *et al.*, n.d.), contingent valuation which is used to measure individuals' maximum willingness to pay for an aspect of a water resource, presented to them in a hypothetical market with a proposed improvement (Economic valuation of water resources in agriculture, 2001).

A valuation on the preservation of lake was conducted using contingent valuation method where a face-to-face questionnaire survey was conducted within the towns adjacent to Lake Volvi. The population of the survey was the households of the towns that surrounded the lake and only grownup members of these households were involved, since they were the ones that could have a more truthful perception of what the value of money is. Households were nominated according to a certain choice depending on the population of each settlement. The individual to participate in the survey from each household was nominated on the next birthday basis. At first, participants were inquired whether they would be at all willing to pay any amount of money for the purpose defined in the valuation scenario. Those not willing to pay any amount were then asked a follow-up question, in order to define the reasons for denying the payment, thereby identifying protesters. The valuation question was dichotomous and it concerned the participants' willingness to pay to conserve and increase the quality of the Lake Volvi. This study concluded that people living around Lake Volvi assign a high value to the conservation and they are willing to offer almost 19 Euros per year from their limited income to contribute to this effort. This can constitute an important tool for all those involved in the management of the area (authorities, experts, non-governmental organizations), as it can be used in the decision-making process, both to help comply with the country's conventional commitments and as proof that sometimes it is more profitable to preserve the natural environmental goods like lake than any other project (Antonopoulou, Latinopoulos, & Mallios, 2014).

Under a state of global climate change, the water ecosystem services of Luan River basin have gained considerable public attention. In that paper, the term of water ecosystem services is called as Green water and blue water formed from the water cycle process to provide the conditions and utility for maintaining the structure and process of forest, grassland, wetland, lake, river ecosystem. In that study, they estimated the magnitudes and economic values of the water ecosystem services in Luan River basin using market value method, afforestation cost method, willingness to pay, reflection engineering method, replacement cost method and opportunity cost method. The economic value of water ecosystem services in Luan River basin was estimated to be 778.32×108 Yuan in 2000. The ratios of the economic values of water direct ecosystem services were 5.89%, and rest 94.11% of the all monetary value was water indirect ecosystem services. Among the water ecosystem services indicators that they estimated was, fruit, timber, fishery products, Fresh water supply, Hydropower and recreation and about 59.81% of the monetary value of water ecosystem services is measured to reflect water resources ecological value (Hao, Yan, Qin, Zhang, & Yin, 2014).

Another study was carried out in Mitilini which is the capital of Levos, the third biggest island of Greece, the aim of that paper was to evaluate environmental benefits resulting from the construction of a Sewage Treatment Plant (STP) in Mitilini, Greece. The main benefits identified were the improvement of the coastal water quality and subsequent impacts on citizens' activities. The valuation was conducted using the Contingent Valuation Method (CVM) through the elicitation of individuals' willingness to pay (WTP). In conclusion, this study attempted to evaluate the benefits resulting from the construction of a STP in the city of Mitilini in Greece. Using the CVM they estimated that the residents of the city were willing to pay D 16.84 every 4 months over a period of 4 years (Jones, Sophoulis, & Malesios, 2008).

Like water factor, property rights also play a greater role in the agricultural productivity and valuation of it leads to the clear understanding on whether farmers are having strong or weak property rights because farmers with full landownership will have a higher value compare to those who has weak ownership (Pochanasomboon, Attavanich, & Kidsom, 2020). If a farmer happens to have a strong property rights, labor moves toward the creation of community assets and there is an improvement in the environmental situation. Environmental improvement such as increase in ground water levels can be the consequence of technical interventions on private land over which property rights are well defined. Once it has an improvement in the environmental situation, yielding of rice will be affected/improved since it is significantly dependent on the environmental factors (Chopra & Gulati, 1997).

Property rights will determine land ownership related factors affecting the application of technologies for agricultural and natural resource management. Strong property rights give sufficient incentives to the farmers to increase their efficiencies in terms of productivity and ensure environmental sustainability. If a farmer happens to have a weak property rights, farmers do not feel emotional attachment to the land they cultivate, do not invest in land development and will not use inputs efficiently. A secure individual land rights will increase incentives to undertake productivity enhancing land related investments. More secure property rights could affect productivity by improving household's security of tenure and thus their ability and readiness to make investments; providing better access to credit; and reducing the transaction costs associated with land transfers (Pochanasomboon et al., 2020).

A case study has been carried out in Khulna District in the South-West region of Bangladesh which tells the effect of sharecropping on rice productivity in some designated areas. A field survey was conducted by using a semi-structured questionnaire in two villages of Khulna District where sharecropping is one of the main land tenure arrangements in rice farming. A Cobb-Douglas production function estimation presented that type of land tenure, use of fertilizers, human labor, and modern variety (MV) including hybrid seed and high yielding varieties (HYVs) of seed had the positive and significant effect on rice production. There was a significant mean difference between the sharecroppers and the owner farmers regarding their volume of rice production. The production volume of the owner farmers was significantly higher by around 781 kg ha-1. The study result from the production function shown that on an average owner farmers' output was significantly higher by 10% than that of the sharecroppers. The study also witnessed that higher land rent in form of a fixed amount of cash or a higher crop share discouraged the sharecroppers to supply the optimal level of input and to use the land intensively. The end result concludes that the sharecroppers are inefficient compared to the landowners. Therefore, it is recommended that sharing an unbiased production cost and a justifiable crop sharing structure might be the better options to inspire the sharecropper to become more efficient concerning their volume of production (Ahmed & Billah, 2018).

Problem statement

People who practices agricultural activities never know how their products are being affected due to the alteration of the water volume and other related factors which will indirectly affects their economy as well as their wellbeing since those impacts are unmeasured and unvalued (Hanley and Spash, 1993).

To overcome those issues, valuation on those non-market values were practiced in this paper. People who practices agricultural activities never knows how factors like water and property right affects their products which indirectly gives an account of their wellbeing. After knowing the value of those non-market product, people's lost and gain due to those factors can be shown in a monetary value and knows how much of money will they be able to get when their water volume to their paddy field is changes from low to high and their lost when their irrigation water volume changes from high to low. Same theory can be applied to the property right of the particular farmer where their lost and gain are measured in terms of monetary value when their property rights changes from sharecropper to the private owner. Because of the valuation methods at least farmers will have a clear understanding on the impacts on their wellbeing due to different associated factors on their agricultural activities.

Similar to the valuation issue, there is also one issue where the impacts on the crop yield was not defined when both environmental factor and socioeconomic factor mix together since no one has seen on this issue before although there is a huge impact on the production level when mixing both the environmental factors and socioeconomic factors (Antwi-Agyei, Fraser, Dougill, Stringer, & Simelton, 2012; Vidal-Macua et al., 2018). To see this water discharge was used to represent environmental factor and property rights as the socioeconomic factor.

Objectives

1. To estimate the association between rice yield and water
2. To evaluate the association between rice yield and property rights
3. To evaluate if the effect of water discharge is heterogeneous between different property rights.
4. To find the economic value of water and property rights.

Methodology

1. Theoretical frame work

By using cobb-Douglas function we can be able to see the relationship between the input variables and the output that can be produced.

$$y_i = \beta_0 {x_{1i}}^{\beta_1} \; {x_{2i}}^{\beta_2} \; x_{1i}{x_{2i}}^{\beta_3} \; X_i^{\beta_4} \; \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

To convert a cobb-Douglas function to a form that can be estimated by using ordinary-least squares regression, we take the natural logarithm of each side. The actual production function estimated was thus

$\ln(Y_i) = ln\beta_0 + \beta_1 \ln(x_{1i}) + \beta_2 ln(x_{2i}) + \beta_3 \ln(x_{1i})\ln(x_{2i}) + \beta_4 \text{In}(X_i)$………2

In equation 2, we are interested in the significance level of water discharge (x_{1i}), property right (x_{2i}), interaction of water discharge and property right (x_{1i})(x_{2i}) on the rice yield. For this we test the following hypothesis:

Hypothesis 1: There is significant effect of water discharge on yield

Hypothesis 2: There is significant effect of property right on yield

Hypothesis 3: There is a significant effect of water discharge which is a heterogeneous between different property rights.

However, we are interested in finding the value of water and property rights. For this we did valuation of both water and property right since both the factors were not expressed in a monetary scale using following equation;

$\frac{dy}{dx} = \beta_k \frac{y}{x}$ …………5 (where k is water and property rights)

We have estimated equation 5, each for water and property rights and to obtain marginal impact of both the factors, we have multiplied by the price of rice in a market for the estimation of actual value of both the factors (k),

$$p \frac{dy}{dx} = p \, \beta_k \frac{y}{x} \ldots\ldots\ldots\ldots\ldots 6$$

2. Study Area

In this study four *Geogs* were taken, two *Geogs* from Punakha Dzongkhag and other two *Geogs* from Wangdue Dzongkhag. *Toewang Geog* with total area of 415.662 square kilometer was taken as one of the sample area and from that *Geog, tsephu, Jara and Yusakha* were my targeted villages. *Bapisa Geog* under Punakha Dzongkhag with total area of 24.6468 square kilometer was another sample area and from there *Sopsokha* was my targeted village. From Wangdue Dzonkhag, *Ruepisa Geog* with total area of 158.72 square kilometer and *Thedthso Geog* with total area of 20.0143 square kilometer were the sample area where *Ruepisa* and *Rinchengang* were taken as my targeting villages which falls under *Ruepisa Geog* and *Thedtsho Geog* respectively.

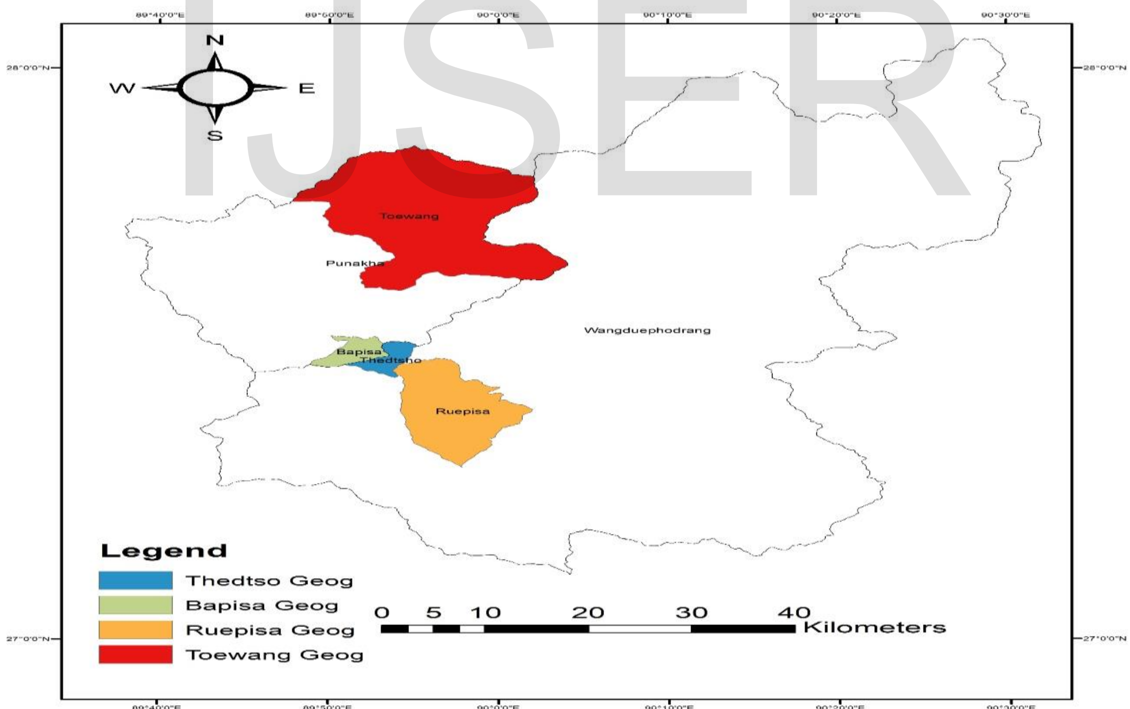

Figure 1: Study Area

3. Sampling method

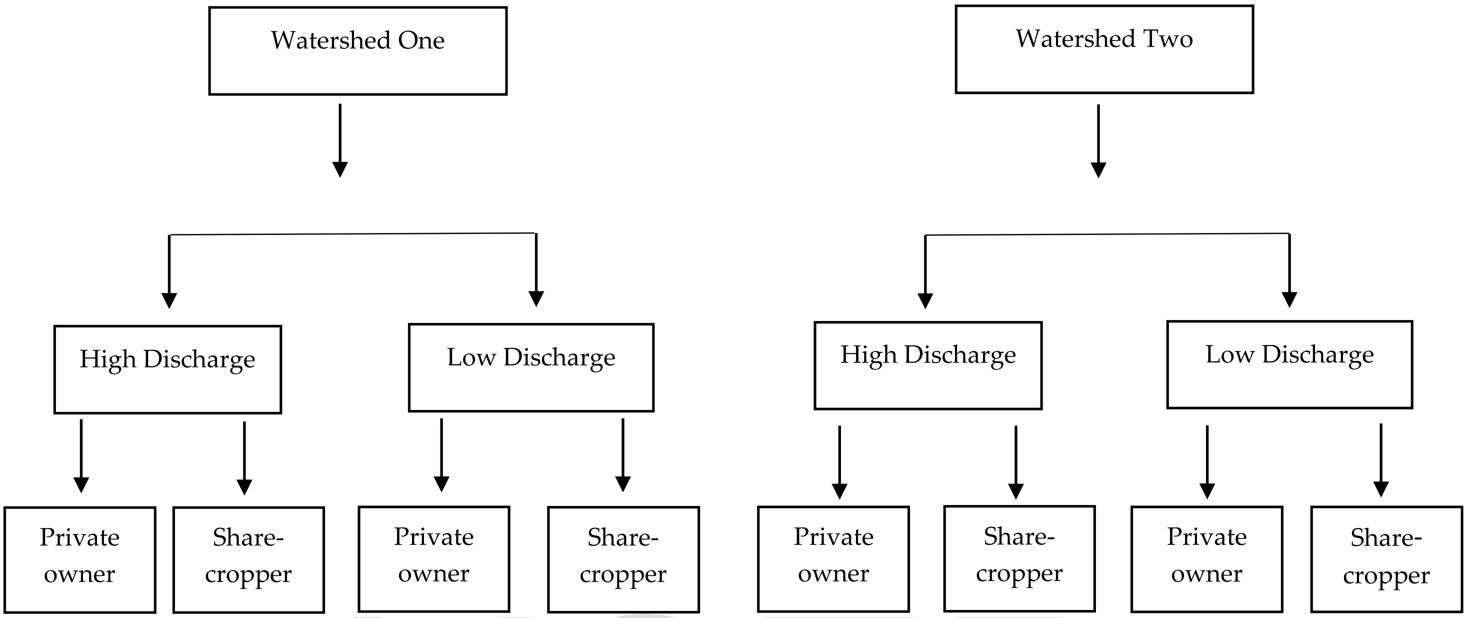

Figure 2: Sampling Tree diagram

Sampling method in this research paper was multi-stage sampling method where it is the probability sampling technique to carried out in several stages such that the sample size gets reduced at each stage (Sedgwick, 2015).

In first stage, two different watershed base on their sizes were located. Stream water which are existing there was measured and classified into two category based on their discharge volume (high and low) in each watershed.

In second stage, households depending upon the different property rights were classified into two category (private owner and share cropper) and for each stream type there were households of two category. In total there were four different categorized households in each watershed (1-watershed one, low stream, private owner, 2-watershed one, high stream, sharecropper, 3-watershed two, low stream, private owner, 4-watershed two, high stream, share cropper).

In third stage, sample households under each category was collected until the desire sample size is met using snowballing sampling method.

3. A) Stream water discharge calculation

Several methods are there to calculate the stream water discharge, there are two methods direct and indirect method. Area-velocity method which comes under direct method was used where it emphasizes on float method where sequence steps were stated below (Wierenga & Michaud, 2005).

First stage; Measured a 10 meter length along the bank of the stream. Made sections of the stream that has a steady flow, avoiding sections with deep pools or rapids.

Second stage; Dropped bottle cap just upstream of the10 meter section marked off earlier, when the bottle cap crosses the end of the 10 m section stopped watch and seen how long it takes to travel 10 m. Did 5 times, dropping it in different sections in the stream (i.e., near the sides, in the middle, etc.) and calculated an "average" velocity.

Third stage; velocity is determined by dividing the distance that the bottle cap travelled by the average number of seconds it took bottle cap to travel the 10 m. The equation is V = d/t, where V = velocity, d = distance, and t = time. We need to keep our units of measurement all the same to find the discharge of the stream, so we will go ahead and convert meters (m) to centimeters (cm). Since 1 m = 100 cm, then 10 m = 1000 cm.

Fourth stage; found the width of the stream at the end of the 10 m section that the bottle cap travelled. Stretched a meter tape across the stream and measured the width in cm. Found the average depth of the stream using the meter sticks and took a depth measurement in every meter along the same meter tape.

Fifth stage; Found the average depth, added all the depths and divided by the total number of measured depth. Then found the area of the stream cross-section using the data from width and depth.

Sixth stage; Found the discharge by multiplying the area of the stream cross-section with the velocity, finally converted this measurement into cubic meters per second (m3 /sec) by dividing cubic centimeters/sec (cm3 /sec) by 1,000,000 since there are 100 cm in 1 m (100 cm × 100 cm × 100 cm = 1,000,000 cm3 to convert to $1m^3$).

3. B) Snowballing sampling method

Probabilistic sampling technique was used where we begin by a small population of known individuals and expands the sample by asking those initial participants to identify others that should participate in the study. In other words, the sample starts small but "snowballs" into a larger sample through the course of the research.

For example, the author listed people of property right sharecropper by identifying one or two sharecropper individuals who are willing to participate in the study. They will almost certainly know other sharecropper individuals in their area and can help author to locate them and those individuals will know other individuals, and so on. Same procedure were used by the author while making a list of individuals with a property right private owner.

4. Sample size

For normal distribution of all the intake data, the probability of all the intake sample in any division should be greater than or equal to 15 (*np ≥ 15 and n (1-p) ≥ 15*) (Arnholt, 2007). In this study, at the top we have set two division (low discharge and high discharge) and each division we have classified into two more sector (private and sharecropper). In order to have a sample size to be normally distributed, total sample size of each division of water discharge was 30 and further divided sectors with the sample size of 15.

Analysis

The data was analyzed using multiple regression statistical tool and the association between various variables were found using equation 7.

$$Y_i = \beta_0 + \beta_{1i}x_{1i} + \beta_{2i}x_{2i} + \beta_3 x_{1i}x_{2i} + \beta_4 X_i \text{ ....7}$$

The dependent variable is rice yield (Y), predictor variables are different stream discharge (x_1), property right of different household (x_2), and confounding factors like education level, occupation, household size, gender for the head of the family and number of machineries they own. From the above existing equation number 7, we have drawn the impact or the association of individual variables with the dependent variable rice yield. Even an impact due to the interaction of stream discharge and property rights were obtained. We found the value of both stream water and the property right of different house hold using equation 8 and 9 where equation 8 was used in finding the value of water and equation 9 for finding the value of property rights of different households.

$$p\ \frac{dy}{dx_{1i}} = p\ \beta_{x_{1i}}\ \frac{y}{x_{1i}} \text{................8}$$

$$p \frac{dy}{dx_{2i}} = p\, \beta_{x_{2i}} \frac{y}{x_{2i}} \ldots\ldots\ldots\ldots\ldots 9$$

Results and Discussions

1. Results

Table 1: Parameter Estimation

Parameters	B	Std. Error	t	Sig.
Intercept	22.080	.879	25.121	.000
[Discharge=Low]	-4.088	1.243	-3.289	.001
[Discharge=High]	0[a]	.	.	.
[Property right=Private owner]	-7.660	1.243	-6.162	.000
[Property right=Sharecropper]	0[a]	.	.	.
[Low Discharge] * [Private owner]	1.884	1.758	1.072	.286
[Low Discharge] * [sharecropper]	0[a]	.	.	.
[High Discharge] * [Private owner]	0[a]	.	.	.
[High Discharge] * [sharecropper]	0[a]	.	.	.

1.A Association between Rice Yield and water Discharge

When we estimate the association between rice yield and water discharge, where there is high water discharge there is high yield of rice compare to those which has low water discharge. So greater the water discharge, greater will be the rice yield and lower the water discharge, lesser will be the rice yield. As an estimation in terms of high discharge, the rice yield collected is 18.25 Kg per decimal and 15.104 kg per decimal in case of low water discharge and there is a significance difference between rice yield and water discharge, *p=0.001*. When water discharge changes from high to low, the rice yield per decimal is decreases by 4.088 Kg and when the discharge changes from low to high, yield is increases by 4.088 kg. Thus, fulfills the first objective and rejects the null hypothesis which tells that there will be no significance effect of water discharge on the yield.

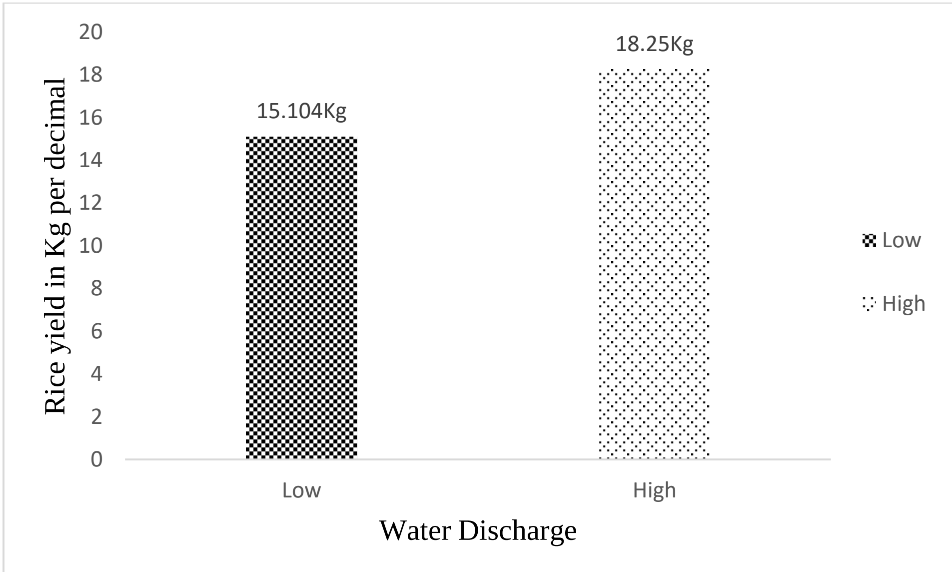

Figure 2: Associations of Rice Yield and Water Discharge

1.B Association between Rice Yield and Property Rights

When we see the association between rice yield and the property rights, large quantity of rice is harvested by those people who has the ownership of sharecropper compare to those people who own their land as a private owner, so sharecroppers collect more rice compare to those who are private owner in same area of given land. When we estimate the rice yield of both the property rights, in case of sharecroppers the collected rice per decimal is 20.036 Kg and 13.318 Kg for those people who has the property rights of private owner. There is a significance difference between the rice yield and the property rights, *p=0.00*. When farmer's property rights changes from sharecropper to the private owner, rice yield gets decreases by 7.66 kg and when it changes from private owner to sharecropper, rice yield gets increases by 7.66 kg per decimal. Thus, fulfils the second objective and accepts the Hypothesis 2 which tells that there will be a significance difference between property rights and the rice yield.

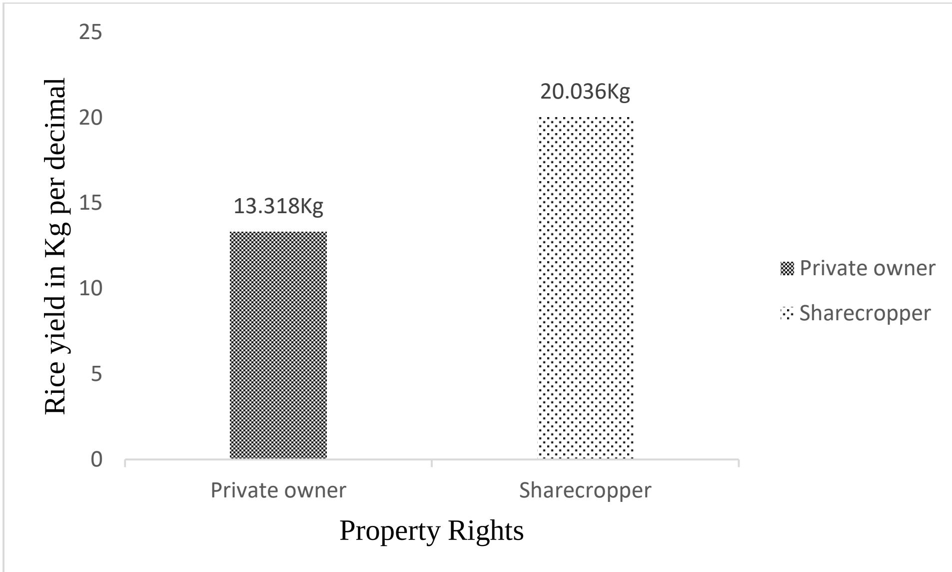

Figure 3: Associations between Rice Yield and Property Rights

1.C Interactions of water Discharge and Property Rights

There is no significance difference on the rice yield when low water discharge and private ownership interact or mixed as its *p-value* is greater than 0.05 but other remaining interactions does have significant effect on the rice yield as their *p-value* is less than 0.05. When we see the effect on rice yield when water discharge is heterogeneous between different property rights, a particular private owner who has low irrigation water discharge collects rice of 12.21 Kg per decimal annually and in case of high irrigation water discharge, there is a collection of 14.42 Kg per decimal annually. People who are being sharecroppers, they collect 17.99 Kg of rice and 22.08 Kg of rice per decimal annually when their irrigation water flow is low and high respectively.

Therefore, we can say that the annual rice yield will be higher if we have a high flow of irrigation water and when our ownerships are sharecropper. But for those people who has low flow of irrigation water and if they happened to be a private owner, their annual rice yield will be low. Thus, fulfills the third objective and accepts the null hypothesis in case of the interaction between low water discharge and private ownership but rejects the null hypothesis in case of other remaining interactions.

1.D Finding the value of water

For the fulfillment of one of the final and main objective that is finding the value of water, equation 8 will be used;

$p \ \frac{dy}{dx_{1i}} = \ p \ \beta_{x_{1i}} \ \frac{y}{x_{1i}}$…………….8

Where p denotes the market price of the rice and we get the market price on an average as Nu. 101.26/-

In order to find the value of water, following given factors will be used;

$p = Nu. 101.26 \ per \ Kg$

$\beta_{x_{1i}} = 4.088 \ Kg \ per \ decimal$

According to the equation 8;

$p \ \frac{dy}{dx_{1i}} = \ p \ \beta_{x_{1i}} \ \frac{y}{x_{1i}}$…………….8

$p \ \frac{dy}{dx_{1i}} = 101.26 * 4.088$

$= 413.95$

Finally we got the actual value of water and that is 413.95. When the volume of water changes from low to high and since water discharge has a significant effect on the yield, the income to the farmer from the rice will be increased by Nu. 413.95 Whereas if the volume changes from high to low, the income of the farmer will be decreased by 413.95 since the value of water is 413.95.

1.E Finding the value of Property Rights

For the fulfillment of the final and main objective that is finding the value of property rights, equation 9 will be used;

$$p\ \frac{dy}{dx_{2i}} = p\ \beta_{x_{2i}}\ \frac{y}{x_{2i}} \ldots\ldots\ldots\ldots\ldots 9$$

In order to find the value of property rights, following given factors will be used;

$p = Nu.\,101.26\ per\ Kg$

$\beta_{x_{1i}} = 7.660\ Kg\ per\ decimal$

$p\ \frac{dy}{dx_{2i}} = p\ \beta_{x_{2i}}\ \frac{y}{x_{2i}}$

$p\ \frac{dy}{dx_{2i}} = 101.26 * 7.660$

$= 775.65$

The actual value of property right is Nu. 775.65/- which can be concluded as if the property right of a farmer changes from private ownership to the sharecroppers, their income from the rice will be increased by Nu. 775.65/- compare to those private owners, but if their property rights get changes to private ownership then their income will be decreased by Nu. 775.65 compare to those sharecroppers since there is a significant effect of property rights on the rice yield. Thus fulfills the final and the main objective.

2. Discussions

The Direct market-based valuation estimates consumer's benefits and producer's benefits using market price and quantity data regarding the environmental goods/services traded in the market, but this method has several limitations and drawbacks. First, since only a few environmental goods/services are bought and sold in the markets, its coverage is limited. Secondly, market imperfections distort prices and, therefore, affecting the measuring of net benefits. Prices also vary seasonally and cyclically. Further, the ambit of market economy depends on the level of development of an economy. In less developed economies many resources that contribute to the produce brought to the market go unaccounted and thus are not reflected in the prices (S.K.Mishra, 2012).

It may also be noted that estimation of net economic benefits depends on estimation of consumer and producer surpluses, which in turn, depends on the specifications of the demand and the supply curves. Depending on the specification, the functional relationships between demand, supply and their determinants may be overwhelmingly complicated or too simple. The functional relationships may be linear or non-linear, bivariate or multivariate and so on. The list of determinant variables (such as income, prices of substitutes, prices of other goods, etc.) may not be an easy task to make. Due to all these, the estimation of consumer as well as producer surplus will be model dependent. Consequently, the estimated net benefits also would be model dependent (S.K.Mishra, 2012).

However it does have advantages, firstly due to that valuation People's values are likely to be well-defined as it reflects an individual willingness to pay for costs and benefits of goods or services that are bought and sold in markets, secondly data are relatively easy to obtain, thirdly it uses observed data of actual consumer preferences and further it uses standard, accepted economic techniques (Hoevenagel, 1994). It is also easy to grasp and communicate, mostly it is quick and relatively easy to conduct(Susan, 2012).

Ecosystem valuation can be difficult and a controversial task, and economists have often been criticized for trying to put a price tag on nature. However, agencies in charge of protecting and managing natural resources often make difficult spending decisions that involve trade –offs in allocating resources. These type of decisions are economic decisions, and thus are based, either explicitly or implicitly on society's value. Therefore, economic valuation can be useful, by providing a way to justify and set priorities for programs, policies that protect or restore ecosystems and their services(Adeyemi, A., Dukku, .S.J., Gambo M.J. Kalu, 2012).

When we estimate the association between rice yield and water discharge, it was found out that there is a mild correlation between water discharges and there is a significant relation between rice yield and water discharge ($r=0.261$, $p<0.05$). As an estimation in terms of high discharge, the rice yield in watershed one per decimal collects 17.05 Kg and in case of low discharge, it collects 16.43 Kg. In case of watershed two, same association is seen where 19.44 Kg of rice per decimal is collected in high water discharge and 13.77 Kg per decimal is collected in low water discharge. On an average rice yield in high water discharge is estimated 18.24 Kg per decimal and 15.1 kg per decimal in case of low water discharge. So, where there is high water discharge there is high yield of rice compare to those which has low water discharge because when there is adequate amount of water, large amount of paddy plantation can be easily done and even in the condition of extreme practice of evapotranspiration, there will no observation of shrinkage or drying of paddy plants. But in case of inadequate water supply, even if we have a larger area of land, we cannot extend or grow more paddy plants and due to the practice of evapotranspiration there will be an issue of shrinkage and drying of paddy plant which directly leads to the reduction of rice yield. So it can be concluded that, greater the water discharge, greater will be the rice yield and lower the water discharge, lesser will be the rice yield.

One case study has been carried out where it was found out that irrigation is the most important factor, which affects the productivity of the crop up to a great extent and when the rainfall is uneven and erratic, the water supply becomes inadequate for irrigation and such problems of meeting crop water requirements arise. So when water supply is less than the crop water requirements, the yield of crop gets affected. An experiment has conducted where two varieties namely ADT-36, a short-term variety and SONAM, a medium term variety were tried for the experimental study. Soil moisture depletion of 60% and 40% of field capacity were considered for experimentation. The study showed that the yield was affected due to water stressing because there is an observation where yield reduction was found less in 40% stress treatment compared to 60% stress treatment in various stages. So water discharge (water availability) has a greater impact on the rice yields(Govindan, 2015).

In case of the association between rice yield and the property rights, we can see strong correlation compare to the water discharge ($r=0.55$, $p<0.05$). A large quantity of rice is harvested by those people who has the ownership of sharecropper compare to those people who own their land as a private owner, so sharecroppers collect more rice compare to those who are private owner in same area of given land. When we estimate the rice yield of both the property rights, on an average the rice yield harvested per decimal is 20.03 Kg and 13.31 Kg for those people who has the property rights of sharecropper and private owner respectively.

But there is one study carried out in Bangladesh on the impact of property rights on the rice yield and there contradictory stated that there was a significant mean difference between the sharecroppers and the owner farmers regarding their volume of rice production. The production volume of the owner farmers was significantly higher by around 781 kg ha-1. The study result from the production function revealed that on an average owner farmers' output was significantly higher by 10% than that of the sharecroppers. The study also observed that higher land rent in form of a fixed amount of cash or a higher crop share demotivated the sharecroppers to supply the optimum level of input and to use the land intensively. The result implied that the sharecroppers are inefficient compared to the landowners. Therefore, it is recommended that sharing an equitable production cost and a justifiable crop sharing structure might be the better options to motivate the sharecropper to become more efficient concerning their volume of production(Ahmed & Billah, 2018).

Though the aforementioned case study contradicts to my finding, it still supports the sharecroppers that, compare to the private owners the productivity would be higher to those who are a sharecropper if there is an equitable production cost and a justifiable crop sharing structure. Since the people of my study area has an equitable production cost and justifiable crop sharing structure, there is a finding that sharecroppers are better than those private owner in terms of crop production. And also since the sharecropper needs to give certain share to the actual owner, they put extra hard work compare to those private owner and leads to the higher production of rice quantity.

In case of mixed factor, there is different impact on the rice yield where we can say that the annual rice yield will be higher if we have a high flow of irrigation water and when our ownerships are sharecropper. But for those people who has low flow of irrigation water and if they happened to be a private owner, their annual rice yield will be low. Because rice evolved from a semi-aquatic ancestor, it is extremely sensitive to water shortage and the main reason is its shallow root system; in terms of sensitivity of rice organs to low water potential, it is actually not that different from many other crops. Leaf and canopy expansion are reduced soon after the soil dries below saturation in most cultivars; even in upland cultivars, expansion begins to be inhibited when only a small fraction of the total available water has been depleted(Pershing et al., 1920). When it comes to the property rights, being a sharecropper is effective in producing large rice yield as sharecroppers put extra hard work in producing large quantity of rice to meet the share demand of their land owner. Therefore, there is a positive impacts to the farmers when high water discharge and sharecroppers interact but negative impact is seen when low discharge of irrigation and private owner interacts.

Finally when it comes to the valuation of water and property rights, we got the actual value of Nu. 413.95/- and Nu. 775.65/- respectively. When farmer's water discharge to their paddy field changes from low to high, they will gain a profit of Nu. 413.95/- compare to those who has low water discharge and in terms of property right, people who are being a sharecropper will have a profit amount of Nu.775.65/- compare to those farmer who is a private owner. When it compares to the water, property right has a higher value which indicates that farmers should be having more concern and cautious and need to put more importance on the property rights as it has a higher value and could have greater impacts on them.

Conclusion

Valuation aids efficient as well as equitable allocation, helps the process of proper distribution, and offers means of achieving better optimality in social consumption and production. Valuation reduces the scope for market failures and enhances its creation: Sometimes, there are goods for which markets do not exist. Examples are certain environmental resources, which are apparently abundant in nature, e.g. air, water, and so on. Because of non-existent markets, there is no market-clearing price.

The valuation of water and property right has never been carried out at a formal, documented level so this paper will provide knowledge for decision makers, particularly the farmers of Punakha and Wangdue Dzongkhag, in proper understanding on how water factor affects their rice yield and what is the actual value of water which directly get a count on their annual profit from the rice production. They will be also enlighten with the knowledge on how factor like property rights affect their rice yield and on the actual value of property rights which has a greater impact on their annual profit from the rice production. And also in case of the people of Wangdue and Punakha valley, farmers who were a sharecropper has a strong property rights as they possess positive and higher value compare to those with private ownership.

In order to have more rice yield at the end of the year, as a strategy or as a technique, farmers should go for the high water discharge and has to be sharecropper since it has a positive impact on their annual rice yield. In case of the value, property right has a more value than the water so, farmers should give more concerns and importance to the property rights.

Recommendation

Since my research work needs to be dependent on people's end rice yield, they do not keep any records of it and they directly tell us through their estimations. So there will be chances of occurring error and May not give the perfect and an accurate result but it does give the approximate result. In order to do away with the error, it would be accurate and perfect if farmers could maintain an annual records of their rice yield.

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