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Effects of Socioeconomic Factors on Tourist Demand and Consumer Surplus

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The IAFOR International Conference on Sustainability, Energy & the Environment − Hawaii 2018
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Abstract
This study constructed tourism demand model considering socioeconomic characteristics and quantitatively analyzed consumer surplus (economic value) according to tourist characteristics. Poisson regression model is commonly used when the count variable such as the number of sightseeing is a dependent variable. Because the target of the analysis is tourists, the truncated Poisson regression model was used in view of the fact that the number of sightseeing is greater than zero. The analysis shows that the truncated Poisson model has more predictive power than the Poisson model. Socioeconomic characteristics (income level, tourism cost, age difference, family members, marital status, gender difference, etc.) had a significant impact on tourism demand. The consumer surplus that tourists get from one trip is around 609,756 won. Estimating the tourism demand of the Korean people considering the socioeconomic characteristics and analyzing the difference of the benefits according to the difference of the socioeconomic characteristics will provide useful information for forecasting the tourism demand, planning the tourism development plan and making the decision.

Keywords: socioeconomic characteristics, tourism demand, economic value, truncated poisson

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Introduction

Interest in quality of life is increasing due to the increase in income level. With the introduction of the five-day workweek in July 2004 and the five-day workweek class in March 2012, the nation's tourism demand for tourism has surged. In the case of the Korean tourism market, the percentage of Koreans spending on domestic tourism is considerably low and the reliance on foreign tourists, especially Chinese tourists, is quite. Recently, it was confirmed that China's restrictions on tourism in Korea related to the Saad placement problem could significantly affected domestic tourism industry. Considering the stagnation of the number of foreign tourists and spending, it is urgent to expand the safety net of the domestic tourism industry. In this situation, it is timely to analyze the factors affecting the national tourist demand in Korea and to prepare countermeasures against them.

Tourism demand is influenced by socio-economic factors. In particular, tourism costs and income are important economic variables in analyzing tourism demand (Becker, 1965). Eugenio-Martin & Campos-Soria, 2011; Shin, Young-Cheol, 2012; Eom Young-suk, 2008). In particular, travel costs can be seen as an important variable in quantitatively analyzing the difference in consumer surplus. Individual characteristics (gender difference, age, education levels etc.) also affect tourist demand and benefit (Lehto, Jang, Achana, & O'Leary, 2008; Berni & Cracolici, 2015; Li, 1985; Ye, & Law, 2013).

The first objective of this study is to develop a national tourist demand model considering the socio - economic characteristics including income level, tourism cost, age difference, household members, marital status, and gender difference. The second objective is to quantitatively analyze benefits from one trip and differences in benefits depending on socioeconomic characteristics. The third purpose of this study is to provide implications based on the results of empirical analysis.

In this study, a truncated Poisson model was used. In general, the Poisson model is commonly employed when the dependent variable is an additive variable such as the number of sightseeing. However, the data used in this study is a questionnaire surveyed by the Korea Institute of Cultural Tourism in 2015. Since non-tourists were not included in the analysis, the number of sightseeing is greater than zero. Therefore, the Poisson model, which is truncated at 0, is appropriate, because of reflecting the characteristics of these data.

This study estimates the tourism demand of Korean people considering the socio - economic characteristics and analyzes the difference of benefits according to the difference of socio - economic characteristics. When analyzing demand for individual entities on a microeconomic basis, prices and income should be included in the analysis of national tourist demand as a key variable. Economic variables are important, but if they are omitted from the model, there is a bias or inconsistency in the estimation coefficients. Therefore, a model with economic variables will have more rigorous results than those without. The second feature is the analysis of the difference of benefits from tourism according to the difference of socioeconomic characteristics. Unlike most studies analyzing the relationship between individual characteristics and tourism demand, the difference in benefits according to individual characteristics was estimated quantitatively. At this time, the price variable (travel

cost) included in the model can be used to estimate the benefit difference of individual characteristics.

Section II discusses the theoretical background of the tourism demand model. Section III provides the truncated Poisson model used in the analysis and the estimation of the benefits of individual characteristics. In Section IV, the data and analysis results are presented. In Section V, the research results are summarized, implications are discussed.

Literature Review

Tourism is generally classified into international tourism and domestic tourism, which is defined as national tourism including overseas tourism of Koreans and domestic tourism of Koreans (Lee, 2004). To estimate the demand for national tourism, economical major economic variables are income and price. First, it is necessary to understand income effects and substitution effects to see how income changes affect tourism demand. Income effects indicate that the higher the income, the greater the demand for tourism. However, as wage increases, incomes increase, but the relative value of leisure increases, so tourism demand decreases i.e., substitute effects (Becker, 1965). Therefore, the effect of income on tourism demand is determined by the relative size of income effect (+) and substitution effect (-). Generally, income effects are known to be larger than alternative effects.

Van Soest & Kooreman (1987), Eugenio-Martin & Campos-Soria (2011), and others have analyzed the impact of income levels on tourism demand. Van Soest & Kooreman (1987) analyzed the impact of income on tourism demand in 1981 in Dutch consumption expenditure data. The impact of income on tourism demand was positive, but the effect of domestic tourism demand on international tourism demand was different. Income has a negative effect on domestic tourism demand, but it has a considerable positive effect on international tourism. Eugenio-Martin & Campos-Soria (2011) analyzed the relationship between income and tourism demand in 1977, using household data from 15 European countries. As a result, it was found that the higher the income, the higher the demand for tourism.

The other major economic variable is tourism costs (prices). Tourism costs include hotel charges, transportation costs, and opportunity costs for time. The higher the price, the less demand for tourism. Price variables are used to estimate the difference of consumer surplus according to the difference of individual characteristics. Tourism costs are considered to have the characteristics of the visiting area and the value of the natural environment.

Lehto, Jang, Achana, & O'Leary(2008), Berni & Cracolici(2015), Szromek, Januszewska, & Romaniuk(2012), Li, Ye, & Law(2013) analyzed the difference in preference of tourism demand according to the generation difference for the US domestic tourists. These studies found that elderly households prefer to travel on casinos, gambling, and wellness, but found that the baby boomers prefer to increase their intimacy through family trips. Berni & Cracolici (2015) analyzed the tourism behavior of Italian furniture from 1997 to 2007. As age increases, tourism demand decreases, but tourism expenditure increases. The income elasticity of tourism for each household is different.

The method of estimating tourism demand and its benefits is based on the travel cost method (TCM). The travel cost method includes economic variables (income and price) in the tourism demand model for evaluating the value of tourism demand and tourism resources. In particular, travel costs are used as surrogate variables of tourism service prices to estimate the difference in benefits resulting from differences in individual characteristics. The benefit of individual characteristics can be estimated by dividing the estimated coefficients of individual characteristics by the estimated coefficients of prices.

Most of the domestic researches applying the travel cost method evaluated the value of tourism demand or resource in a specific area by analyzing the tourists visiting specific areas. There is no research that analyzes the difference in benefits from tourism due to differences in the benefits according to the socioeconomic characteristics.

The literature provides several findings. First, the effect of income on tourism demand is positive (+) and tourism is normal good. Second, the effect of price on tourism demand is negative. Third, the economic variables (income and tourism cost) are important variables for estimating tourism demand. Based on these findings, this study estimates the tourism demand model considering socioeconomic variables and estimates the difference of tourism benefit according to individual characteristics. A survey used in this study was conducted for non – tourists. Therefore, the truncated Poisson model was used to reflect the characteristics of the data, and a robust standard error method was used in consideration of the possibility of dispersion.

Methods

The number of a tour is determined by maximizing utility with a limited budget. At this time, tourism demand can be expressed as a function of socio-economic characteristics (income, tourism price, sex, education level, age, etc.).

Before estimating the difference in benefits according to socioeconomic characteristics, tourism demand function should be estimated. In this study, we use the truncated Poisson model to reflect the characteristics of the data. The Poisson model is generally used because the dependent variable is an integer as the number of tour services. However, in the case of surveys targeting tourists, the demand for tourism ranges from 1, which is greater than zero. Most studies analyzed tourist demand except for the responses of 0 when information on the responses of those who did not participate in the tourism activities were not available (Bockstael, Strand & MacConnell, 1990). The results of the conventional regression or Poisson model that do not adequately reflect the response of 0 are likely to be undesirable. Therefore, considering truncation of observations may provide reliable results (Grogger & Carson, 1991; Cameron & Trivedi, 2005, 2009).

Poisson model is widely used for explaining the probability of occurrence of certain incidents (frequency of violent crime, number of hospital visits, number of visits, etc.) in a certain period (Cameron & Trivedi, 2005, 2009). The probability density function of the univariate Poisson distribution with respect to the number of trips (y) in the tourism sector during one year can be expressed as follows (Cameron & Trivedi, 2005, 2009; Habb & McConnell, 2002).

$$\Pr(y|\mu) = \frac{\exp(-\mu)\mu^{y}}{y!}, \qquad y = 0,1,2\ldots. \tag{1}$$

where y is the number of trips occurring in a year, and y is the parameter to be estimated. The Poisson distribution is characterized by the fact that the average and variance of the number of travels occurring in a specific period are the same. As a survey of people who have actual tourism experiences, the number of tourism, which is a dependent variable, has a positive value. In order to reflect the characteristics of these data, a truncated Poisson model with a dependent variable of 0 is more suitable than the Poisson model. The probability density function that reflects the characteristics of the cut data is shown in Equation (2).

$$f(y|\theta, y > 0) = \frac{f(y|\theta)}{1 - F(0|\theta)} \tag{2}$$

where $f(y|\theta)$ is a probability density function, $F(y|\theta)$ is a cumulative distribution function, θ is parameters estimated. $F(0) = \Pr[y \le 0] = \Pr[y = 0] = e^{-\mu}$.

In the tourism demand model, the dependent variable is the number of tourism and the socio-economic characteristic variable is the explanatory variable (3). The regression model of the exponential form guarantees $\mu_i > 0$ (Agresti, 1996).

$$\mu_i = E(y_i|x_i) = \exp(x_i\beta) \tag{3}$$

where i is the number of visits by respondents, and μ_i is the average and variance of the number of visits by i respondents. And x_i is a vector representing the socioeconomic characteristics (price, income, sex, education level, etc.) of the respondent and is an unknown parameter to be estimated. The estimation method is the maximum likelihood estimation (MLE), and the parameter is the solution obtained from the first-order condition of the nonlinear equation (4).

$$\sum_{i=1}^{N}\{y_i - \exp(x_i'\beta)\}x_i = 0 \tag{4}$$

From the estimated tourism demand model, it is possible to calculate the differences in economic value according to the social characteristics. At this time, the welfare analysis on tourists can be implemented using the approximate compensation change and the consumer surplus. By integrating the lower part of the estimated demand curve, consumer surplus is calculated. The change in the expected number of trips due to changes in prices represents expected consumer surplus and can be obtained from Eq. (5) (Hellerstein & Mendelsohn, 1993).

$$E(CS) = \frac{E(y|X)}{(y-1)!} = -\frac{\mu}{\beta_p} \tag{5}$$

Here, the average number of trips is the estimated coefficient of prices. Therefore, consumer surplus per trip is the reciprocal of price estimation coefficient. The

difference in consumer surplus due to socioeconomic factors can be estimated using equation (6).

$$E(\Delta CS) = -\frac{\delta E(y_i)/\delta x_i}{\beta_p} = -\frac{\beta_i}{\beta_p}\mu \qquad (6)$$

Here, μ is the average of the number of trips, β_0 is the estimation factor of tourism price, and β_i is the estimation parameters of ith explanatory variable. Therefore, the change or difference in consumer surplus per tour according to the different characteristics can be obtained by dividing the estimated coefficient by the estimated coefficient of price.

Empirical Results

In order to analyze the relationships between socioeconomic characteristics and tourism demand, this research employs the National Tourism Research Institute 's 2015 National Travel Survey. This data provides sufficient observations and information necessary for analysis. The survey was conducted between January 1 and December 31, 2015. Out of the sample of 6534 households with 2492 households over 15 years of age living in South Korea, 5736 samples were finally used except for no answer or outliers.

Table 2 presents definitions and basic statistics for the variables used in this study. Dependent variable is addition data as annual number of trips. It is confirmed that it is larger than 0 because it is a survey data for tourists. Therefore, the truncated Poisson model may represent this feature. The explanatory variables influencing the number of tourism are socioeconomic characteristics (tourism price, income, individual gender, age, education level, household size, etc.), tourism price and income are selected based on economic theory, the literature, and data availability. Among the explanatory variables, gender, marital status, and tourism type are the dummy variable, and the difference of the reference variable can be analyzed. The tourism type were included because domestic tourism and international tourism may have different effects on tourism demand and convenience. The sample average of the average number of sightseeing trips per person over the past year is 8.83, and the sample variance is 360.24, so there is scattering. Therefore, more rigorous model setting is necessary through the test of the model.

<Table 1> Summary statistics in variables

variable	explanation	mean	std. err	min	max
trip	number of tourism per year	8.83	18.98	1	305
price	tour price(cost of a tour: 10000won)	28.56	78.97	0	2000
y	average monthly income(10000won)	366.34	254.74	3	1250
sex	sex(female=1; male=0)	0.59	0.49	0	1
age	age	52.17	18.93	15	97
school	year of education	4.25	1.56	1	8
fsize	size of households	3.10	1.41	1	9
marry	marriage(married=1; unmarried=0)	0.57	0.49	0	1
type	tour type (domestic=1; international=0)	0.92	0.27	0	1

Table 2 shows the estimated results of the Poisson regression model (model 1) and the truncated Poisson regression model (models 2 to 4). As we have seen in the data analysis, there was a possibility of over-dispersion where the variance of the number of trips (360.24) was larger than the average (8.83). To test this, the test method proposed by Cameron & Trivedi (2005, 2009) was used. If the predicted value of the model is $\widehat{trip}$, $\widehat{trip}$ is regressed on $[(trip-\widehat{trip})^2-trip]/\widehat{trip}$. The t-test is performed to determine whether the coefficient of $\widehat{trip}$ is 0 or not. If the estimation coefficient is significant, there is an over-dispersion, and if not, it can be judged that there is no over-dispersion. The results show that all models have over-t dispersion, so a robust standard error method was used.

Akaike Information Criteria (AIC) information criterion and Bayes Information Criteria (BIC) information criterion indicate that the lower the value, the higher the fit of the model. Since model 4 have the lower AIC (88180.99), BIC (88234.23) than the other models. Model 4 holds the highest fitness. In the case of Model 4, all estimated coefficients have statistically significant effects on tourism demand. Estimation coefficients of trip costs are statistically significant negative and consistent with economic theory. In other words, the higher the travel cost, the smaller the number of trips. The coefficient of estimation of income is significant (+), which means that the higher the income, the greater the number of trips. Estimates of age are positive signs, indicating that the larger the age, the greater the number of visits. Although older respondents have some limitations on their ability to operate, they can be seen to have relatively high tourism demand based on high economic power. In Korea, men are more likely to be employed and economically than women. The estimation coefficient of gender (female = 1) is a negative sign, meaning that the number of trips is smaller for women than for men.

Estimation coefficients of marital status (married = 1) were positive, which means that more members of the family have more trips than married single (unmarried, divorced, bereaved). The coefficient of the tourism type (domestic tourism = 1) is negative (-), indicating that international tourism has higher demand than domestic

tourism. Although it is not included in model 4, the coefficient of estimation of school is positive (+), and the higher the education level, the higher the demand for trips.

<Table 2> The result of estimated tour demand models

	Poisson	Truncated Poisson		
	model 1	model 2	model 3	model 4
price	-0.0124***	-0.0166***	-0.0161***	-0.0164***
	(0.0002)	(0.0025)	(0.0025)	(0.0025)
y	0.0013***	0.0013***	0.0011***	0.0014***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
sex	-0.4082***		-0.4096***	-0.4661***
	(0.0547)		(0.0552)	(0.0511)
age	0.0129***	0.0142***	0.0169***	0.0100***
	(0.0025)	(0.0025)	(0.0026)	(0.0024)
school	0.0686***	0.1177***	0.0680***	
	(0.0185)	(0.0171)	(0.0189)	
fsize	-0.1257***	-0.1288***		-0.1300***
	(0.0315)	(0.0318)		(0.0156)
marry	0.1393*	0.1728*	0.0327	0.1765***
	(0.0116)	(0.0117)	(0.0484)	(0.0841)
type	-0.3831	-0.4878*	-0.4776*	-0.503**
	(0.2478)	(0.2632)	(0.2624)	(0.2637)
constant	1.7710***	1.3993***	1.4366***	2.3438***
	(0.3620)	(0.3480)	(0.385)	(0.3624)
Heteroskedasticity test	-2.60***	-2.49**	-2.41**	-2.37**
AIC	88885.87	89680.05	88752.15	88180.99
BIC	88945.76	89733.28	88805.39	88234.23

Since the Poisson model is a nonlinear model, it is difficult to interpret the estimated coefficients. Therefore, the estimation coefficient of the nonlinear model can be interpreted as a general linear model by converting it to the mean marginal effect. <Table 4> shows the results of the average marginal effect. In the case of model 4, the marginal effect of price is -0.1435, and if the cost of tourism is 10,000 won lower, the number of trips is 0.14. The marginal effect of income is 0.0124, and if the income is 10,000 won higher, the number of trips is 0.012 more. The marginal effect of age is 0.088, which is as many as 0.088 times the age of one year old. The marginal effect of the number of family members is -1.1405. In case of married status, the number of the trips is 1.52 times more than that of non - domestic travel, and domestic travel is 4.41 times smaller than international travel.

<Table 3> Marginal average effects

	Poisson	Truncated Poisson		
	model 1	model 2	model 3	model 4
price	-0.1098***	-0.1457***	-0.1414***	-0.1435***
	(0.0190)	(0.0245)	(0.0246)	(0.0011)
y	0.0113***	0.0114***	0.0098***	0.0124***
	(0.0012)	(0.0012)	(0.0010)	(0.0011)
sex	-3.603***		-3.5931	
	(0.516)		(0.5173)	
age	0.01141***	0.1248***	0.1479***	0.0880***
	(0.0222)	(0.0221)	(0.0218)	(0.0213)
school	0.6053***	1.0323***	0.5967***	
	(0.1649)	(0.1569)	(0.1684)	
fsize	-1.1100***	-1.1303***		-1.1405***
	(0.2687)	(0.2691)		(0.2758)
marry	1.2295*	1.5158*	0.2870**	1.5482*
	(0.6664)	(0.6764)	(0.5385)	(0.6587)
type	-3.3828	-4.4279*	-4.1901*	-4.4114*
	(0.2478)	(2.3549)	(2.3469)	(2.3603)

Consumer surplus per trip using Equation (7) is calculated, and the results are shown in Table 5. In case of Model 4, the consumer surplus of respondents from one trip is about 609,756 Korean won (about $550). In the case of the Poisson model (model 1), the consumer surplus for one trip was 806,451 Korean won(about $750), which overestimated the consumer surplus over the cut Poisson model, while the cut Poisson model (model 2, model 3, model 4)

<Table 4> The economic value of a trip

	model 1	model 2	model 3	model 4
economic value	806,451	602,409	621,118	609,756

<Table 5> shows the consumer surplus difference of one trip according to the different individual characteristics. The Poisson model (Model 1) is presented for comparison with the optimal model, Model 4 (the truncated Poisson model). As in Table 4, the Poisson model overestimates the difference in consumer surplus by characteristics over the truncated Poisson model. In the case of model 4, the higher the income is 10,000 Korean won (about $90), the higher the consumer surplus from one trip is 865 won ($7.8). When the age is 1 year old, the value of the one-time canal is 6129 Korean won ($5.6) higher, and the value of one time tour is lower than male by 284,837 won. Respondents with family members rated the value of one trip higher than that of the other one by 107,837 won, and the respondents gave a high value of 307,264 Korean won($280) to international tourism than domestic tourism.

<Table 5> The economic value of tourism by socioeconomic characteristics

	model 1	model 4
y	1029	865
sex	-328104	-284724
age	10390	6129
school	55109	N/A
fsize	-101065	-79437
marry	111945	107837.1
type	-307990	-307264

Conclusions

In this study, we estimated the tourism demand function considering the socio - economic characteristics and measured the difference of benefits according to the differences in socio - economic characteristic. Considering data characteristics the truncated Poisson model was used and a robust standard error adjusted for the over-dispersion was employed. Consumer surplus per trip and the difference of consumer surplus according to the difference of individual characteristics were calculated based on the tourism demand model with high fitness (model 4).

In Korea, it is necessary to appropriately estimate and analyze national tourism demand and benefits for tourism policy to promote domestic tourism. In this study, the socioeconomic characteristics that were overlooked in the previous studies and the difference of the benefits according to the differences in socio-economic characteristics. From the analysis results, the following suggestions can be obtained. First, the greater the age, the higher the benefits for tourism, which may be an important policy consideration at this time of rapid aging. In the aging society, it is necessary to plan for the increase of tourism demand and benefit of aged population.

Second, the benefits of international tourism are much higher than those of domestic tourism. It is necessary to promote tourism benefits through the development of domestic tourist facilities and tourist sites. In Korea, there is a high level of dissatisfaction with domestic tourists due to the lack of sightseeing spots, tourist infrastructure, and relatively high tourist expenses. Taking this into consideration, it is expected that the expansion of tourism infrastructure and the reduction of tourism cost will contribute to revitalizing domestic tourism by increasing the level of welfare through the recreation and emotional content of tourists. This will increase the level of welfare through tourist recreation and emotional content. This information can be used in promotional and marketing strategies and tourism policy decisions.

Third, in order to improve the accuracy and predictability of analysis, it is important to select models that reflect the characteristics of theory and data. According to demand theory, economic variables (price, income) are the main variables to be included in the tourism demand model. In particular, price variables are important for measuring benefits and differences in benefits according to the different socio-economic characteristics. If the key economic variables are included in the model, the

accuracy of the estimates will be increased. It is necessary to select a model that reflects the characteristics of the data, such as the response processing and over-dispersion. The results of this study show that the truncated Poisson model and robust standard error method can deal with this problem adequately. This will provide useful information for tourism demand analysis, planning for the development of tourism industry, and decision - making.

Unlike most studies evaluating the tourism demand or the value of resources in the specific area, this study analyzed general tourist demand and benefits per trip. The difference in benefits according to the different characteristics was estimated. The methodology was chosen to reflect the features of the data, and in order to enhance the robustness of the estimation results, rigorous diagnostic tests and various models were compared.

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How Do Executives' Values Influence Corporate Responsibility Adoption

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Abstract
This research paper is a working paper, which seeks to explore how executives' values influence CR adoption. Paucity of qualitative research that provides insights into the complexity of executives' value-to-action translation processes highlights a significant research gap in understanding the importance of Strategic Leadership on CR adoption beyond normative theories. This paper adopts an interpretive research paradigm using a semi-structured interview method to gain an in-depth understanding of how their management decisions and behaviours are being influenced by their values. Sixteen senior executives were interviewed. The interviews revealed that executives' past experiences are instrumental in shaping their value principles, their value awareness and their value strength. Further, findings revealed that the ongoing learning these executives gleaned from culmination of experiences continues to reinforce those value principles, which in turn guides their ongoing behaviours. This research paper aims to contribute to furthering knowledge in strategic leadership and how it could enhance CR adoption. To enable organizations to strive towards sustainable and responsible practices, how values influence executives' fields of vision and their interpretation of information needs to be understood by management practices.

Keywords: Corporate Responsibility, Corporate Social Responsibility, Strategic Leadership, Values

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Introduction

Corporate responsibility (CR) is the responsibility of a business towards its larger set of stakeholder group to maintain its license to operate. Because the concept of CR is voluntary and discretionary (McWilliams and Siegel, 2001), it is de facto a value-laden concept. However, in mainstream management literature, the values influence on CR adoption from the upper echelon of organizations is largely ignored.

Strategic Leadership theory posits that senior executives are responsible for shaping their organizations' strategic direction (Cannella et al., 2008) . According to Rokeach (1973), values are central to behaviour. Executives' value systems therefore will have significant influence on organisational approaches to CR adoption (Hemingway and Maclagan, 2004; Hemingway, 2005). Not only do their value systems act as perceptual filters (England, 1967) which influence how the executives scan, interpret information((Phipps, 2012; Nadkarni and Narayanan, 2007) and indirectly trigger CR adoption (Hemingway, 2005; Hemingway and Maclagan, 2004), their moral values are found to reinforce existing organizational values that influence individuals' values (Duarte, 2010; Gini, 1997; Klettner et al., 2014). Further, executives' value priority and the awareness were found to influence the strength of values on behaviour (Verplanken and Holland, 2002). Value priority allows individuals to make trade-offs between competing priorities (England, 1967; Schwartz, 2012), while value awareness allows explicit articulation of one's values and enhances their strengths (Strand, 2011). Hence, the influence of executives' values influence on CR adoption is also contingent upon their own awareness of their value priority and the strength of their personal values.

Research method

Paucity of qualitative research that provide insights into the complexity of value-to-action translation processes (Hemingway, 2005) highlights a significant research gap in understanding the importance of strategic leaders (i.e. executives) (Strand, 2014) on CR adoption beyond normative studies. Many qualitative researchers criticized the inadequacy of positivist studies in understanding the humanness in social science (Lincoln and Guba, 1985). This is because positivist empirical studies tend to focus on the causal relationships between individuals' values and different levels of CR performance or actions. The results were inconclusive findings, falling short of validating the bearings established by normative theories that values are at the centre of what governs our behaviour and actions (Margolis and Walsh, 2003; Margolis and Walsh, 2001). Hemingway (2005) and Crane (2000) criticized the dominance of quantitative methodologies with a positivist orientation. This predominance of positivist research methods to study values in management, denies the possibility of values as socially constructed and ignores the importance of humans as the potential "free agents" at the nexus of organizational strategies and strategic decisions. This highlights current research gaps, whereby the adoption of different research approaches could yield different insights into how values influence responsible practice.

Values are not directly observable (Chin et al., 2013), however they can be brought to awareness through discursive consciousness (Giddens, 1984). Hence, this research inquiry adopts an interpretive research paradigm, using interview methods to enable in depth exploration of meanings behind actions.

This research inquiry is currently a work in progress, targeting twenty executive interviews of which sixteen have been completed. The interview data was analyzed based on the following four main topics:

- Executives' life experience and defining moments
- Influence of life experience on executives' values and beliefs
- Executives' attitudes towards CR
- Executives' CR adoption actions and management behaviours

Four main themes emerged from the data analysis: 1) *Triggers*, 2) *Beliefs*, 3) *Context* and 4) *Practice.* A summary of the emergent themes is illustrated in Table 1.0.

Table 1.0 Emergent Themes

Trigger	**Belief**	**Context**	**Practice**
Encountered Challenges	Fulfillment • Make an Impact • Life Priority	Locus of Control	Care for Employees
Formative Values	Personal Values • Principle-centred • Convictions • Others	CR Attitudes • Biz Sustainability • Obligations • CR Outcomes	Set Culture
Personal Growth	Perspective	Worldview • Financial Health • Tone at the Top • Org. Culture	Drive Change

Emergent Themes

Triggers

"*Triggers*" are significant life and professional experiences the executives shared with the researcher. As the executives retold various defining moments in their lives, they reflected on these moments and shared with the researcher how these "triggered" events or culmination of pieces of their lives' snapshots influenced their personal and professional paths, shaping who they are today as an executive.

There are three subthemes under "*Triggers*". The two subthemes 1)*Encountered Challenges* and 2) *Formative Values*, highlight how these defining moments of experience made an imprint on the executives' self-identity. The third subtheme "*Personal Growth*" reflects executives' introspection on their own development through time, life stages and different exposures to different life experiences.

In one case, the notion of sustainable practice came to this executive rather serendipitously. He was dropping his children off to school and he saw a sign with a red circle and a line across it warning people that the neatly manicured lawn had harmful chemicals. He then thought to himself,

> *It was pretty ridiculous in my head that people's lawns were plagued with pesticides that could potentially be dangerous for young kids in areas where young kids were known to be playing, in playgrounds, in school yards and so on.*
> *Executive, Commercial Service*

This challenging encounter consequentially spurred a series of actions taken by this executive including lobbying the government for regulatory changes and impacting his business strategy on sustainable practices.

Formative Values, which reflect the cultural values an individual was exposed to through their various influences such as family, religion and corporate environment, were found to lay the foundation of values and beliefs for the individual executives. These values are often deemed as acceptable norms in the communities and the companies in which the executives were brought up. Through a series of *Encountered Challenges*, these *Formative Values* were either reinforced or challenged.

This executive, shared with the researcher how his *Formative Values* were formed:

> *So I had taken a university course as part of my electives in feminism and so I don't see gender in the workplace.*
> *Executive, IT*

The following *Encountered Challenge* reinforced his *Formative Values:*

> *This guy proceeded to use the most misogynistic language talking about my manager. I couldn't believe it. I had never seen sexism in the workplace.*
> *Executive, IT*

The third sub-theme *Personal Growth* highlights executives' self reflection on their personal development and the meanings implied from various experiences over time.

This executive reflected on how his thinking has evolved through his professional journey:

> *In my previous last employment, was a period during which my own thoughts in this regard shifted pretty considerably…*
> *Executive, Consumer Services*

Their past experiences and meanings behind their experiences formulate the executives' respective value priority and strength. Their values continue to evolve as new experiences, new thoughts, new revelations emerge through the passage of time.

Beliefs

"*Beliefs*" reflect the belief system of the executives. Belief system includes their value priority and attitudes (Rokeach, 1968). Executives seldom articulate their values and beliefs directly but rather it is through their stories retold, and their own introspection and reflections on the experiences, that their values and beliefs surface in their narration. Therefore it is the meanings extracted from their own experiences that brought out the executives' values and beliefs.

There are three main subthemes under "*Beliefs"* identified as: 1) *Fulfillment; 2) Personal Values; 3) Perspective*

This executive's definition of *Fulfillment* demonstrates that he knows he is making a difference to fight climate change. He said,

> *Earning a lot of money right now isn't important to me…. So success now is about making some difference in what's going on in X. I feel strongly aligned with the purpose of this organization…. that gives me a lot of personal satisfaction, and gets me up here every day.*
> *Executive, Consumer Service*

Anchoring their actions on a set of *personal values* is a common theme across many of the interviewees. On the topic of bribery, this executive said with assertion,

> *We started doing a whole series of business in Country X. And again the issue of bribery came up. And I said that no, I don't want to become involved with bribery.*
> *Executive, Chemical*

This executive's rationale behind his decisions to pull out was anchored on his belief that his products could bring tremendous customer value and therefore he believed that he did not need to be held hostage by his customers.

Another executive reflected a strong conviction around a particular issue.

> *I believe strongly in climate change… influence of man on climate, it's never been a doubt for me…*
>
> *… [A] lot of people agree and they believe it, [but] very few people are really doing anything that makes the difference.*
> *Executive, Consumer Service*

These strong *personal values* or convictions become the motivation behind their actions.

The last subtheme highlights executives' *perspectives* on the world. It is the lens through which they view the world. The notion of "short-termism" or "linear thinking" appears amongst many of the interviews as a criticism of executives' myopia with regards to decision-making.

> *[I]f you look at any of those right things in a very kind of quarterly profit very short term driven perspective, you might miss doing the right thing.*
> *Executive, Private Equity*

Many of the participants commented on the long-term damage companies could wreak upon themselves if they focus on short-term results, negating factors that enable long-term success.

Context

Executives' perception of their context and the meanings derived from their world, when combined with their values and beliefs influence their actions and behaviours.

Values and beliefs, according to Rokeach, are constructed at a general abstract level. Actions and behaviours on the other hand are context and situation specific. Values and beliefs influence how individuals perceive their environment, the information they would collect and possess (Cannella et al., 2008). And so it is through their perception of the context that their values and beliefs influence actions and behaviours.

One of the sub themes emerged is *Locus of control*, which is the perception of individual power to drive change and his or her ability to align his or her own beliefs with actions.

Back to the story where the executive was upset about the pesticide used in lawns, he said,

> *We were successful in changing local policy… it was interesting for me to see that there are things happening out there that make absolutely no sense, [and] until someone steps up and actually challenges what is being done is wrong for a number of reasons, it would continue to happen.*
> *Executive, Commercial Service*

He further added that it is,

> *[I]n having the realization that you can make a difference, and you can change; or otherwise [nothing] would be changed, had you not got involved and taken a stand.*
>
> *So that was enlightening for me.*
> *Executive, Commercial Service*

This executive's *locus of control* was reaffirmed with his lobbying success. And in turn his positive experience enhanced his sense of power, reinforcing his own values and beliefs.

Another executive believes he has the responsibility to drive change, he said,

> *I just think we have personal responsibility to change. And that is not just environmentally or socially, but I think from an innovative [perspective], those who stand still get left behind. I just totally believe that. And I think you know shame on the executive who wants the status quo even at the great risk that comes with [the inevitable environmental] change.*
> *Executive, CIO*

Another emerging theme is *CR Attitude*. This sub-theme reflects executives' CR beliefs, and what CR means to them from a normative perspective. Many believe that businesses have obligations towards their stakeholders, the society and the wellbeing of the environment. However, many also believe that business sustainability in terms of financial health is equally important.

This executive explained the balance that businesses need to maintain:

> *[T]hey're there to make a profit and to make the right business decisions, but they also have to be very mindful of the approach that they're having on the community in which they live.*
> *Executive, Retail*

Another emerging theme is *Worldview*, which reflects executives' perception of their business reality, reflecting the meaning they derived from the world they experience through their own lens, influenced by their values and beliefs. Tone at the top is one of the emerging subthemes.

Many believe that change lies at the top, and the top needs to set the example.
The same executive from this Commercial Service Company saw the CEO as the most important position that would influence an organization's CR adoption. He said,

> *[I]t's the senior executives in an organization that need to be engaged, and need to be motivated to drive this type of activity. You have a CEO that is not*

> *committed; that for some reasons is not an executive that feels passionate about something that is bigger than what the company is trying to do; and I would tell you that individual's done a disservice to his shareholders, a disservice to his team members.*
> *Executive, Commercial Service*

Board also plays an important role. This executive who also held board positions, believed the board is even more critical than the CEO. He said

> *One of the most important jobs of the board is to pick the right CEO. And if you pick a CEO without putting in what are the values we expect from the CEO, then the board is not doing their job.*
> *Executive, Chemical*

Practice

The theme "*Practice*" illustrates the decisions, actions and behaviours executives undertake based on their values and beliefs and their understanding of their own reality – their "*Context*".

Tying *Practice* to the importance of *Tone at the Top*, *Setting Culture* is considered by many interviewees as a key part of their actions to enable the adoption of CR and sustainable practices. Hence, *Setting Culture* emerged as a sub-theme under *Practice*.

This executive recalled his very first - most effective – alignment exercise he devised was hosting multiple weeklong retreats to build value alignment amongst his teams. With a set of aligned values, he believed they could create a company that reflected a strong set of corporate values as a team. He said,

> *I insisted on a very open conversation, a very vulnerable one about who we were as people and what we wanted to accomplish as a business.*
> *Executive, Private Equity*

With a set of aligned values, Private Equity Executive sought to set the right example through hiring and firing practices. He added,

> *[W]e started at the top and making it a priority and making it a touch stone the way that we operated. But then frankly we made it happen throughout the whole organization. Not just by declaring this is the way of the world, [but] acted on it by hiring and firing.*
> *Executive, Private Equity*

In terms of *Driving Change*, another emergent sub-theme under *Practice* that the Chemical Company executive shared with the researcher was his story of innovating and changing the way chemicals were transported in Canada to create a fail-safe way of transport. He explained that the old tank cars that were used to transport chemicals on

rail, when there was a rail accident, the tankers could get punctured and the spill could be very dangerous to the people living in the communities where the accident happened, and could cause significant damage to the environment. Under his leadership the company redesigned the safety valve of those tank cars so that in the event of any derailment accident, the spill could be safely contained.

He said with great pride,

> *So since 1981 to today, despite of [the many] unit trains crisscrossing the continent all the time. You've not heard of [a major] sulphuric acid spill.*
> *Executive, Chemical*

The Commercial Service executive demonstrated CR adoption actions when he lobbied to change government policies and led the way in transforming his business practices. His company was the first to ban the use of toxic chemicals in cosmetic lawn care. He successfully lobbied the municipal government to ban all toxic pesticides for use in areas where children would be seen playing. These were transformational changes that altered government and business practices.

When asked if he was faced with resistance or challenges, he said some clients did resist, but very quickly, he and his team managed to influence change upon their clients. He said,

> *We met with senior executives of our client organizations to try to explain how the alignment of the brand and image around environmental stewardship was being eroded … and basically you know they got it pretty quick that you know, being a leader means you do things that are different than everyone else.*
> *Executive, Commercial Services*

This Executive worked tirelessly to convince others to adopt the change – that is the right thing to do – the principle and the mission of his company:

> *So we had to work hard to try and get the client to embrace the concept of relaxing their economic business case performance in exchange for some benefits around the brand and image.*
> *Executive, Commercial Services*

Care for Employees is another subtheme that emerged under *Practice.* It reflects executives' personal behaviours towards their employees.

This executive said,

> *I believe in helping people be successful. That's kind of job one for me…. if they're successful, I enjoy their success too.*
>
> *Executive, Transport*

Many also articulated that *caring for others* gave them fulfillment and was part of what success meant to them.

Discussions

Values and beliefs provide motivations for individuals' actions (Schwartz, 1987) The strengths of these values and beliefs are reinforced by the valence of the outcomes from their actions (Posner and Schmidt, 1984; Elizur and Sagie, 1999).

Some of the actions and decisions discussed under the three emergent CR adoption themes *(Care of Employees*, *Set Culture* and *Drive Change)* reflect executive's individual personal behaviours more than organizational initiatives or decisions. These actions do not necessarily reflect firm objectives, or strategic plans, but rather a set of personal actions that these executives explicitly wanted to undertake as a result of their values and beliefs. This finding reveals that the influence of personal values is significant at a personal level in terms of actions and behaviours. Strategies are by and large calculated. However, in terms of business situation dilemmas, organizational culture, and social and environmental issues, values play a significant role as reflected by the executive's narratives, in how they treat employees and how they set the culture. Further, they can also influence the nuances of strategy depending on the executives' perception of their locus of control.

It is found that *Triggers* from past experiences create certain beliefs and affect the strengths of those beliefs and values. These values and beliefs in turn influence their perception of their context. It is therefore the combination of the strengths of these values and beliefs, as well as context, which influences executives' actions regarding CR adoption.

Amongst the stories shared by some of the executives, several reflected life changing traumatic events. These life-altering events appear to have had an impact on the executives' value awareness and the strength of their values. These *Triggers* act like an amplifier on the *Formative Values* these executives were brought up within, taught during their lives, or otherwise influenced by. Values and beliefs, whether they were raised under some unfortunate circumstances or through positive reinforcement, in a few of the examples discussed have revealed an important role they play in influencing the types of actions executives chose to undertake. The strengths of their values and beliefs matter when it comes to motivating the individuals into actions.

The Commercial Service Executive reflected on his various experiences and the importance of personal experiences in shaping who he is now as a leader. He remarked,

> *[T]he experiences of a senior executive establish the direction of the organization, or candidly, the individual's perspective on life. I shared with you these examples [the stories he told of his past], because they have a dramatic effect on the areas that I have been focused on and the investment of time and resources that I personally made.*

Conclusions

The contribution from this research paper towards theory is to deepen our understanding of the role values play in influencing executives' actions with regards to CR adoption. There remains a lack of understanding around how leaders' values influence corporate responsibility adoption. Many studies adopt a positivist approach to understanding specific relationships between values, CR and sustainability performance outcomes (e.g.(Agle et al., 1999; Ramasamy et al., 2010; Chin et al., 2013)). But little is known in terms of how values translate into actions ((Meglino and Ravlin, 1998; Eyal et al., 2009; Groves and LaRocca, 2011).

The contribution this research paper seeks to make in management practice is to highlight the need to focus on strategic leadership and how it influences organizational strategies, in particular focused on CR adoption. To enable organizations to strive towards sustainable and responsible practices, how values influence executives' fields of vision and their interpretation of information, which then influence their behaviours and their enterprise decisions, needs to be understood by management practices. "Values" within strategic leadership theory is underexplored in management research, in business education, in leadership development, and in executive selection (Groves and LaRocca, 2011).

In conclusion, if we would like to make bigger strides toward more ambitious and more transformational goals we need to look at: 1) executive recruitment: who do we hire, and how do we select these executives becomes important. Their values matter – the strength of their values matter as influenced by their experiences; 2) leadership development and business education for the next generation of leaders, including board members, on how we raise the importance of individuals' value principles and convictions, so that personal motivation becomes the force needed to drive positive change and CR adoption.

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Case Study of Administrative Planning in Japan: Initiation Stage of Citizen Participation and Information Sharing in Child Rearing Support Plan

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Abstract
In Tokyo, encouraging the acceptance of childcare centers is an urgent issue as many children still need a nursery. The Japanese government has implemented an institutional reform, and local governments have formulated a new child rearing support plan along with the reform. However, the reform is focused on extending the duration of child care at nurseries and on increasing the capacity of nurseries. Consequently, kindergartens and small childcare facilities with short childcare durations are concerned about not being able to attract customers or even face closure. This study reports the case of City A in Tokyo, where an innovative approach was adopted in the formulation of an administrative plan, which entailed considering the opinions of various stakeholders and evaluating them at the planning stage. The method involved tracking the progress of the city's child rearing support plan from the beginning to its completion and interviewing the staff in charge of planning. In City A, while investigating the demand for services expected of the new plan, opinions from small childcare facilities, kindergartens, child rearing support NPOs, etc. were also gathered. In a departure from the usual conduct of administrative plans, in City A, citizens were included in the process of gathering information, which happens prior to the formulation of the draft. The Administrative Procedure Law of Japan does not have provisions for administrative planning, and no measures enable the participation of citizens in this process. The case of City A offers a solution to this problem.

Keywords: Japan, local government, administrative plan, administrative survey, information sharing.

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Introduction

As Japan's birth rates continue to decline, the population in metropolitan areas, such as Tokyo, continues to increase. At the same time, municipalities continue to be faced with depopulation, and this may polarize the populations in these regions.

One reason for the concentration of the population in metropolitan regions is that they offer many opportunities for employment. Young people who migrate to big cities in search of employment also get married and raise their children in the cities. Given these reasons, population concentration in metropolitan regions seems inevitable [Tokyo metropolitan government, 2016a], which, however, could be curtailed if opportunities for employment in rural regions increase significantly. This may also counter the effects of depopulation in these regions. Conversely, many parents in Tokyo find it difficult to work and raise their children simultaneously. This problem is compounded by the shortage of childcare centers in Tokyo [Tokyo metropolitan government, 2016b]. Therefore, it is important to increase the acceptance rates of childcare centers in big cities to reduce the number of children on waiting lists.

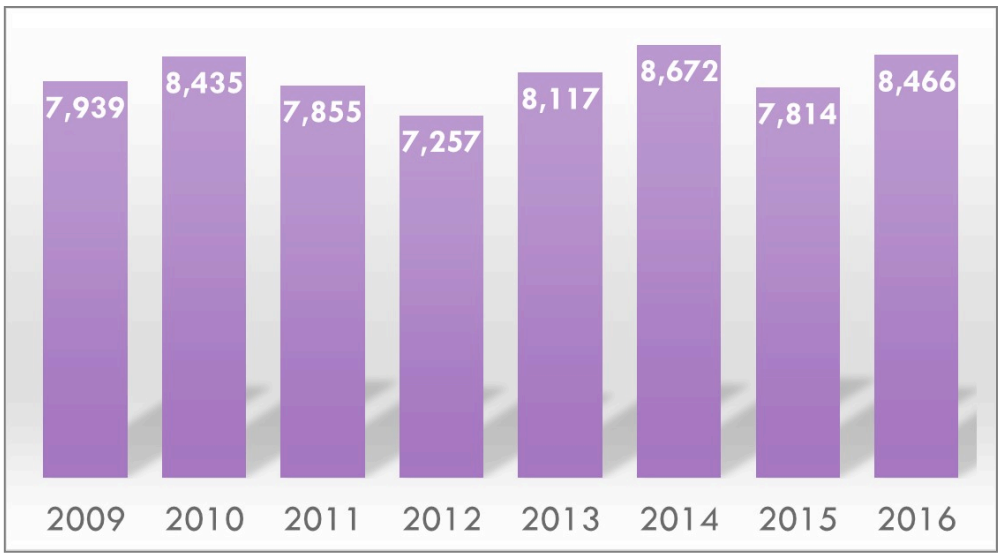


Fig.1. Number of children on waiting list for children care center in Tokyo. Figure based on [Tokyo metropolitan government, 2016b].

To counter this problem, the Japanese government enforced the Child and Child Care Support Act (Act No. 65 of 2012). In effect, this Act served to increase the acceptance rate and the duration of the enrollment process at childcare centers as well as kindergartens. The Act also allowed working parents to deposit and started a new system from FY2015 [Cabinet office, government of Japan, n.d.]. In FY2013, the Tokyo Metropolitan Government stated that it aimed to eliminate the need to place children on waiting lists of kindergartens and childcare centers by FY2017 [Tokyo metropolitan government, 2015a].

Although the Japanese government and the Tokyo Metropolitan Government have initiated these measures, municipalities are best suited to, and most capable of, addressing this problem effectively. As the basic form of local government, municipalities deal with residents more frequently, and this equips them to address this problem in a more effective manner.

The Tokyo Metropolitan Government requested municipalities in Tokyo to formulate administrative plans to eliminate the need to place children on waiting lists of childcare centers until FY2017. Consequently, the "Child Rearing Support Plan" was introduced in the municipalities in FY2015 [Tokyo metropolitan government, 2015b.].

Background

The Administrative Procedure Act, enacted in 1993 in Japan, does not grant provisions for administrative planning. The lack of provisions to do so is a crucial issue in the context of administrative law [Takagi, Tsuneoka, and Suda, 2017].

The Administrative Procedure Act was last revised in 2005, and this revision empowered the general public to offer proposals or comment on proposed policies. In addition, governmental bodies were obligated to consider public opinion. In effect, the revision allows the public to control administrative planning to a reasonable extent.

It is also necessary to reform the legal system to increase public participation levels in administrative activities. The Administrative Procedure Act is likely to be revised to accommodate the need for more public participation. It is expected that the revision would focus on the ease of participation and the interests of the general public [Ushijima, 2016].

Local governments are expected to set up councils involving experts and residents to draft administrative plans. More importantly, the councils will be consulted in the drafting process. Residents can also influence administrative plans and express their opinions and interests by participating in workshops, conferences, hearings, and surveys [Isozaki, 2012].

At the local level, administrative plans are classified into three types: (i) comprehensive plans, (ii) basic plans, and (iii) individual plans. Comprehensive plans represent the highest level of administrative planning. Basic administrative plans typically pertain to welfare and urban development. Individual administrative plans represent a level lower than basic administrative planning. The "Child Rearing Support Plan" is an example of an individual administrative plan, whereas measures such as "Community Welfare Administrative Planning" are examples of basic administrative plans. Individual administrative plans are typically based on concrete and specific information; they pertain to the everyday lives of citizens. These plans are typically based on estimates such as the number of children who may be admitted to nurseries and other child care facilities over the next ten years. Individual plans also typically involve many stakeholders. For example, child care services are provided by nurseries, kindergartens, "childcare mothers," child rearing support NPOs, and other facilities. Although a large number of children are placed on waiting lists of childcare centers, setting up a public daycare center may endanger private daycare centers. Setting up public daycare centers may even result in the phasing out of private facilities. Therefore, it is highly difficult to address the needs and interests of all stakeholders equally.

This paper considers the case of CITY A, given the groundbreaking manner in which it formulated its administrative plans, and how, in doing so, it was also able to address the interests of various stakeholders. CITY A’s case also allows one to identify the

means to address the needs and interests of various stakeholders in an equal manner, especially in the case of administrative planning.

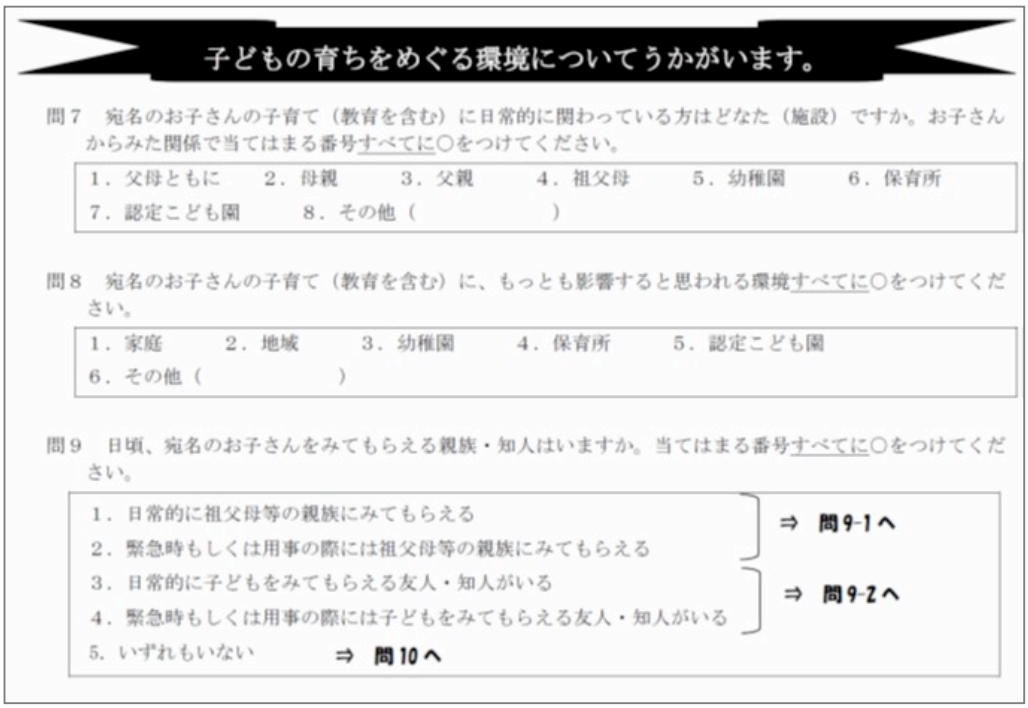
Study

In FY2014, CITY A, located at the center of Tokyo, formulated a child rearing support plan, with a focus period of 10 years from FY2015 to FY2024. This administrative plan was formulated with the help of a council, which included citizens, representatives from child rearing support NPOs, representatives from parents' associations (especially parents of nursery school students), and academic researchers. In total, the council was comprised of 18members. Moreover, CITY A's child rearing support plan was based on survey questions designed by the municipal council.

1) Survey design

Typically, formulating an administrative plan involves the evaluation of previous administrative plans; surveys are also conducted to determine the changes and improvements expected by various stakeholders. Moreover, in most cases, demand surveys are the only means available to express public interests and opinions. More often, the opportunity to answer surveys is mistaken for citizen participation.

In order to formulate a strong child rearing support plan, the Japanese government distributed a draft questionnaire (as a form of demand survey) to municipalities across the country. The draft questionnaire consisted of 23 pages. Although it did not indicate the direction of the survey items, the questions and the possible answers were described in detail. The draft questionnaire was divided into two parts: (i) mandatory items and (ii) arbitrary items. And municipalities were bound to investigate the mandatory items.



子どもの育ちをめぐる環境についてうかがいます。

問７　宛名のお子さんの子育て（教育を含む）に日常的に関わっている方はどなた（施設）ですか。お子さんからみた関係で当てはまる番号すべてに○をつけてください。

1．父母ともに　2．母親　3．父親　4．祖父母　5．幼稚園　6．保育所
7．認定こども園　8．その他（　　）

問８　宛名のお子さんの子育て（教育を含む）に、もっとも影響すると思われる環境すべてに○をつけてください。

1．家庭　2．地域　3．幼稚園　4．保育所　5．認定こども園
6．その他（　　）

問９　日頃、宛名のお子さんをみてもらえる親族・知人はいますか。当てはまる番号すべてに○をつけてください。

1．日常的に祖父母等の親族にみてもらえる
2．緊急時もしくは用事の際には祖父母等の親族にみてもらえる
⇒ 問9-1へ

3．日常的に子どもをみてもらえる友人・知人がいる
4．緊急時もしくは用事の際には子どもをみてもらえる友人・知人がいる
⇒ 問9-2へ

5．いずれもいない　⇒ 問10へ

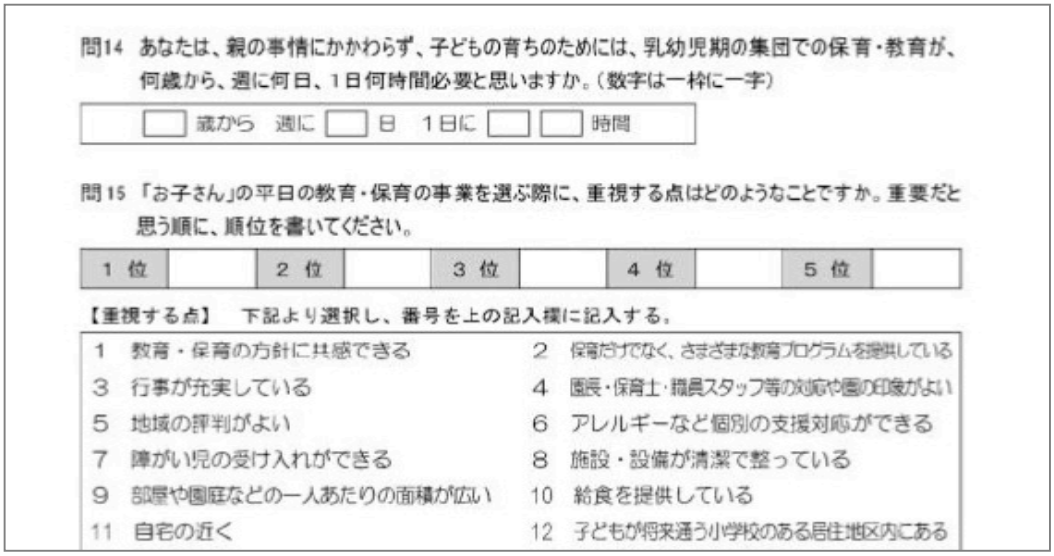
Fig. 2. A draft questionnaire of the Japanese government.
Figure adapted from [Nishitokyo, 2014a].

Typically, the Japanese government does not take part in the administration of demand surveys. As a rule, local governments design and implement the draft investigation items. However, since the formulation of a child rearing support plan was an urgent task, the Japanese government took it upon itself to distribute the questionnaire.

Many local governments used the questionnaire unaltered; in other words, the questions and items formulated by the Japanese government were not modified. A large number of municipal councils only showed the findings of this demand survey in one meeting.

Generally, moreover, the public is not afforded the opportunity to influence the research design. Citizens are only expected to participate in surveys.

CITY A, however, deleted the list of arbitrary items indicated by the Japanese government. Instead, questions deemed urgent by CITY A's municipal council were included in the questionnaire. CITY A also considered the needs and interests expressed by the council members. CITY A invited questions from the council members, and the members were encouraged to share the concerns they faced not only as individuals but also as representatives of their respective organizations. For example, CITY A requested the representatives of the parents' association to recruit and discuss questions at meetings organized by the association. Compared to other municipal councils, CITY A directed more resources and efforts toward designing questions for the survey.



問14 あなたは、親の事情にかかわらず、子どもの育ちのためには、乳幼児期の集団での保育・教育が、何歳から、週に何日、1日何時間必要と思いますか。(数字は一枠に一字)

□ 歳から 週に □ 日 1日に □□ 時間

問15 「お子さん」の平日の教育・保育の事業を選ぶ際に、重視する点はどのようなことですか。重要だと思う順に、順位を書いてください。

1 位		2 位		3 位		4 位		5 位	

【重視する点】 下記より選択し、番号を上の記入欄に記入する。

1	教育・保育の方針に共感できる	2	保育だけでなく、さまざまな教育プログラムを提供している
3	行事が充実している	4	園長・保育士・職員スタッフ等の対応や園の印象がよい
5	地域の評判がよい	6	アレルギーなど個別の支援対応ができる
7	障がい児の受け入れができる	8	施設・設備が清潔で整っている
9	部屋や園庭などの一人あたりの面積が広い	10	給食を提供している
11	自宅の近く	12	子どもが将来通う小学校のある居住地区内にある

Fig. 3. Invited questions from the council members (CITY A).
Figure adapted from [Nishitokyo, 2014b].

2) Council Meetings

Most municipal councils scheduled meetings based solely on their Presidents' schedule, and there was usually no room to change the date, venue, or the timing. Details were usually communicated to the members a week or two ahead of a meeting, and the meetings were held once every quarter.

The members of CITY A's municipal council, however, were given annual calendars, which also indicated dates for the meetings. Schedule adjustment can be selected on weekdays and Saturdays, morning, afternoon and nighttime, it was decided on the day when many members can participate.

Once finalized, members were given notice two months prior to a meeting. Necessary items were also mailed in advance, and members received these mails at least two weeks prior to the meeting. The meetings were held once every month.
In addition, nursery and daycare facilities were provided for members with children. In some cases, makeshift nursery rooms were also set up to accommodate the children.

Discussion

1) Survey design

Compared to other municipalities, CITY A encouraged and ensured greater public participation. For instance, members of CITY A's municipal council were involved in designing the questionnaire for the demand survey. The council was instrumental in gathering and consolidating the opinions of the various stakeholders; these opinions were also incorporated in the design of the demand survey.

The positive effects of CITY A's inclusive method are listed below:
The survey embodied the diverse perspectives, needs, and concerns of the stakeholders. By doing so, CITY A was able to create a level playing field for the stakeholders. This allowed otherwise marginalized opinions and interests to be shared and reduced the influence of dominant stakeholders. Stakeholders and council members were involved in reviewing the survey questions, whereas, in most other municipalities, stakeholders and council members were involved only in discussing the results of the survey. Compared to other municipalities, CITY A also devoted more time (the council devoted three months) to design the survey questions. As a result, members and stakeholders were able to understand the significance and implications of the survey questions. This in turn paved the way for vigorous debates and discussions. As the concerns and interests of all stakeholders were noted, it became possible to share impartial and unbiased data.

2) Meeting management

The annual calendar allowed council members to plan for the monthly meetings in advance. Moreover, the two-month advance notice for meetings enabled members to prepare effectively. A flexible schedule was adopted in consideration of the members' diverse lifestyles. In addition, nursery and daycare facilities were provided for members with children.

Conclusion

Typically, local governments do not encourage citizens to participate in the process of drafting an administrative survey prior to the drafting of an administrative plan. Citizens are usually only allowed to participate in surveys as respondents. As a result, the questionnaire of administrative survey typically do not reflect the citizens' interests.
CITY A, however, has favored an all-inclusive process. The municipal council was instrumental in encouraging public participation from the stage of gathering

information. Citizens of CITY A were involved in every crucial stage of the formulation an administrative plan. In order to address the often diverse, and sometimes conflicting, interests of various stakeholders, it is important to gather and record data in an objective manner. This also paves the way for fruitful discussions and debates. This case study also shows that it is important to encourage public participation in order to gather more relevant and objective information. This in turn allows governments to formulate effective administrative plans.

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Information Sharing and Administrative Planning: From Japan's Local Government Ordinances

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Abstract
There is presently no provision for administrative plans under the Administrative Procedure Law of Japan. In administrative planning, utilizing the amendment of the Administrative Procedure Act and the stipulation of the procedure for public comment in 2005 enables control over the level of discretion involved in the planning process to a certain extent. Further, the establishment of a legal system promoting public participation in administrative activities, such as the procedure for formulating plans that the Administrative Procedure Law has made a future subject, is also desired. Notably, in Japan, it was the local governments that introduced the process of sharing information with residents, as in the case of the information disclosure system, before the national government, which did so only after it had already been established in several municipalities. This research is aimed at investigating the ordinances passed by local governments in Japan. This way, the study's aim is to contribute to the national government's efforts to further revise the Administrative Procedure Act. This study examines the ordinances passed by Kanagawa Prefecture and Nagano Prefecture for their respective municipalities. Kanagawa Prefecture was the first local government to ordinate an information disclosure system in Japan; Suwa City in Nagano Prefecture established the administrative plan for the ordinance of the first administrative procedure in Japan. Enabled by this process, several guidelines were formulated that aid in providing information to residents, being helpful in the contexts of prescribing administrative plans and sharing information. This study suggests ways and means of furthering this cause.

Keywords: Japan, local government, administrative planning, ordinance, public comment.

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Introduction

Under Japan's Administrative Procedure Law, there is presently no provision for administrative planning. To a certain extent, utilizing the amendment to the Administrative Procedure Act and the stipulation of the 2005 procedures for public comment enables control over the level of discretion involved in the planning process. The establishment of a legal system that promotes public participation in administrative activities, such as a procedure for formulating plans (a future subject of the Administrative Procedure Law), would also be desirable.

Japan's birthrate is declining and Japanese society is aging, with rural areas becoming depopulated due to increasing urban population density. Local governments are expected to systematically halt population decline. For local governments, it is thus necessary to choose a municipality that people want to live in. To that end, it is important for municipalities to pave the way for citizen participation by formulating administrative plans and implement citizen demands.

Through decentralization, local governments have taken over responsibility for many administrative activities that had been the responsibility of the national government. Municipalities are actively managing the PDCA of administrative activities through citizen participation. It is expected that a system to reflect the voices of citizens will be created in the country through local governments.

Background

Local Autonomy in Japan

Local autonomy is permitted to local public bodies in Japan. This is prescribed and guaranteed by the Constitution of Japan. In addition, the Constitution stipulates that local governments can establish ordinances "within the scope of the laws of the country." Thus, local governments can establish ordinances. (Isozaki, 2012)

According to the latest data released by the Japanese Ministry of Internal Affairs and Communications (2014), there 47 prefectures and 1,718 municipalities in Japan.
Local autonomy generally consists of two elements: "group autonomy" and "resident autonomy." (Takada, 2009)

"Group autonomy" refers to the establishment of an organization (a local public entity, hereinafter referred to as a "local government") that is independent from a country and based on a certain region. The principle of processing local administrations is within the authority and responsibility of this organization.
"Resident autonomy" is the principle of the function of local governments based on the intentions and responsibilities of residents in the area.
Claims have been made that greater emphasis has been placed on group autonomy in Europe and on resident autonomy in the United States. (Mitsunari, 2009)

In Japan, while the importance of the outcomes of group autonomy and the European-type administrative activities have been emphasized, in recent years, there has been a tendency to emphasize American-type autonomy and administrative procedures. The

Administrative Procedure Act of Japan, promulgated in 1993 and enforced in 1994, is one example of this tendency. (Uga, 2016)

Administrative Planning Guarantees and Citizen Participation Procedures in Japan

Administrative plans are discretionary acts.
The legal effects of the administrative plan have (1) legally binding power over citizens, such as the determination of area divisions in town planning, (2) do not have legal binding power over citizens, but do have binding power over the government, (3) provide only national government and local governments with guidelines. There are also some administrative plans that are not legally binding. (Ishizaki, 2013)

Even in an administrative plan corresponding to point (3), if the plan cannot be executed, there is a case for questioning the mayor's political responsibility and citizens' trust in the executive's ability toward administrative execution may be damaged. During planning, the local government, as an organization, collectively confirms the measures' feasibility and verifies the possibility of obtaining the necessary budget. Although the plan noted in point (3) is not a legitimate act of bribery, it substantially constrains the administrative activities of the whole organization over a long period of time and affects the lives of citizens. Therefore, the plan noted in point (3) also needs to reflect citizens' opinions.

In the revision to the Administrative Procedure Act of 2005, a Public Opinion Procedure (Public Comment Procedure, hereinafter "public comment") was stipulated, and the obligation to consider the opinions submitted within the due date for "Order etc." was further stipulated. (Ota, 2016)

By utilizing these provisions for planning administration, it is possible to control planning discretion to a certain extent. However, it is not only public comments but also "legal system development that promotes citizen participation in administrative activities, such as plan formulation procedures that the Administrative Procedure Act has made as a future task" that is desired. In particular, "easy procedures for citizen participation and interest adjustment" are necessary for planning administration. (Ushijima, 2016)

Objective

Under Japan's Administrative Procedure Law, there is presently no provision for administrative planning. In Japan, it was notably local governments who introduced the process of sharing information with residents, as in the case of the information disclosure system, before the national government, which did so only after this process had already been established in several municipalities. This research is aimed at investigating the ordinances passed by local governments in Japan. The study's aim is thus to contribute to the national government's efforts to further revise the Administrative Procedure Act.

Survey

This study examines the ordinances passed by the Kanagawa Nagano Prefectures for their respective cities. Kanagawa Prefecture was the first local government to implement an information disclosure system in Japan; Suwa-City in Nagano Prefecture established an administrative plan for the regulation of the first administrative procedures in Japan. Towns and villages were excluded from the survey, as they do not have advanced information disclosure procedures.

These cities have established their own websites to provide administrative information. The survey was conducted from July to November 2017 by searching for ordinances and outlines on city websites.

The survey items were as follows:

(1) Whether or not an administrative proceeding ordinance has been established. This ordinance is an arbitrary provision not mandated by the national government.
(2) A form of provision concerning public comment.
(3) Under the provision for public comment, whether or not administrative plans are also covered.
(4) Under the provision for public comments, the timing of information sharing of the formulation of administrative plans.

Results and Discussion

Survey item (1)

19 cities in the Kanagawa Prefecture and 19 cities in the Nagano Prefecture were surveyed (Table 1). All of these cities have enacted an Administrative Procedure Ordinance. Of these, only Suwa-City, in Nagano Prefecture, included administrative plans for the application of the Administrative Procedure Ordinance (Table 2). Suwa-City had three articles that specialized solely on administrative plans in their Administrative Procedure Ordinance.

From these results, it was found that the majority of cities do not prescribe administrative plans in their administrative procedure ordinances. As such, Suwa-City is a very distinctive municipality. As administrative plans have not been stipulated in the national Administrative Procedure Act, many cities have been hesitant and have avoided administrative procedure ordinances. Administrative work becomes complicated when guaranteeing administrative plan procedure on the plan through an ordinance. It is thus to be appreciated that Suwa-City has stipulated that including administrative plan procedures in the Administrative Procedure Ordinance is challenging. However, this challenge has proven that the creation of such ordinances did not spread to other cities in Nagano Prefecture where Suwa-City is located and did not spread outside Nagano Prefecture, to the Kanagawa Prefecture.

Table 1. Number of cities in each prefecture surveyed.

	Kanagawa Prefecture	Nagano Prefecture
Number of cities	19	19

Table 2. Establishment of administrative procedure ordinances.

	Number of cities in Kanagawa	Number of cities in Nagano
Established	19	19
Regulations targeting administrative plans	0	1
Cannot found on the Web	0	0

Survey items (2) and (3)

19 cities in Kanagawa Prefecture and 15 cities in Nagano Prefecture had ordinances and outlines describing public comment processes concerning administrative plans. Of these, ten cities in Kanagawa Prefecture and three cities in Nagano Prefecture stipulated the regulations in the ordinance. There were nine cities in Kanagawa Prefecture and 12 cities in Nagano Prefecture that stipulated an outline. Zero cities in Kanagawa Prefecture and four cities in Nagano Prefecture did not publish their regulations on the web (Table 3). With the exception of the four cities whose regulations could not be found on the web, the ordinances and outlines on public comment of all cities were targeted to administrative plans (Table 4).

From these results, it was revealed that there is a tendency to prescribe "regulations, guidelines, outline," which is an internal rule where the mayor decides independently from the "ordinance" where the highest regulations are decided by the city council. If regulated by the ordinance, voting is necessary for revision, which the mayor cannot easily change. This means that citizen participation in an administration plan is guaranteed to be rigid. It was found that cities in Kanagawa Prefecture recognize the importance of the process of formulating and guaranteeing an administrative plan in a more substantial way than cities in Nagano.

The administrative plan was prescribed in Suwa-City's administrative proceeding ordinance, but other cities prescribed the outline concerning the public comment in their ordinances. This suggests that the national government's Administrative Procedure Act did not prescribe administrative plans, and the cities adopted a form consistent with the national government concerning the administrative procedure ordinances.

Public comment procedures are prescribed in the national Administrative Procedure Act, but in many cities, public comment procedures are not prescribed in administrative procedure ordinances, and separate ordinances or outlines have been established. Separating public comment procedures from the Administrative Procedure Ordinance allows for a wider scope of application than that given by the Administrative Procedure Ordinance, where administrative plans, etc. can be included in the scope of application.

The purpose of the Administrative Procedure Ordinance is "securing fairness and transparency in administrative management" and the purpose of the Public Comment Procedure Ordinance is "guarantee[ing]… citizen participation." Many cities have revealed that procedures for formulating administrative plans are recognized as a

means of "guaranteeing citizen participation" rather than as a means for "securing fairness and transparency in administrative management."

Table 3. Rules on public comment.

	Number of cities in Kanagawa	Number of cities in Nagano
Ordinance	10	3
Regulations / Guideline / Outline	9	12
Cannot found on the Web	0	4

Table 4. Rules on public comment and administrative plans.

	Number of cities in Kanagawa	Number of cities in Nagano
Having rules covering administrative plan	19	15
No rules covering administrative plan	0	0

Survey item (4)

In the majority of cities in Kanagawa and Nagano Prefectures, a public comment form based on a draft of the plan was used after the draft plan was completed. There were three cities that stipulated beginning the public comment process at the concept and examination stage, and before the formulation of the original plan (Table 5). Seven cities in the Kanagawa Prefecture and one city in Nagano Prefecture prescribed that the public comment process should be publicized in advance (Table 6).

From these results, as well as the national government's public comment form, there are many provisions for cities to make public comments after a plan draft is formulated. It is impossible to make major corrections after a draft is formulated through the public comment form. Public comments that show drafts and implement them are advantageous in that post-processing can be simplified, but there are disadvantages such that it is difficult to aggregate citizens' opinions. In public comment periods before the draft plan is formulated, information is shared with citizens at the conceptual stage, the concept is devised, and public comment is then incorporated into the draft.

Although seeking public comment at the concept stage means that it takes a long time to formulate a draft and this is disadvantageous, this practice has the advantage that the citizens' opinions are more likely to be reflected in the plan.

Even if a public comment period is opened, it may end before citizens are aware of it. Every city had a public comment period of 30 days or more, but many cities allowed shortening of this period. In order to make public comment procedures work well, it is necessary to inform citizens that cities are requesting public comments. It was notable that cities in Kanagawa Prefecture focused on the importance of information sharing before public comment and emphasized information sharing.

Table 5. Rules on the timing of public comment periods.

	Number of cities in Kanagawa	Number of cities in Nagano
Beginning the public comment process after the formulation of the original plan	2	1
Beginning the public comment process before the formulation of the original plan	17	14

Table 6. Provisions to announce public comment periods.

	Number of cities in Kanagawa	Number of cities in Nagano
With announcement of public comment periods provision	7	1
Without announcement of public comment periods provision	12	14

Conclusion

Below, based on the survey results of cities in two prefectures, the authors summarize several points to be considered when the national government revises the Administrative Procedure Act.

1) Many cities' ordinances other than the Administrative Procedure Ordinance: Whether public comment is considered an administrative management policy or a guarantee of public rights is a significant difference. Even though an administrative plan has no legal binding force, it has a politically binding force and remains part of a serious administrative act for citizens. First, applying administrative plans to the Administrative Procedure Act should be considered. Public comment has already been stipulated in the Administrative Procedure Act. Rather than prescribing public comment as a matter of citizens' rights, this process was stipulated as a means of ensuring the transparency of government administration. In some cities, this process is regulated as a matter of citizens' rights and a democratic process in relation to the national government. The government should, at a minimum, define administrative plans in the Administrative Procedure Act.

2) There were many cities that stipulated an administrative plan not in an ordinance but in an outline, etc.: An administrative plan is expected to be a rigid guarantee which is incorporated into an act such as the Administrative Procedure Act and is not a changeable outline based only on the judgment and decision-making of the chief executive officer.

3) Methods for easy participation: It should be stipulated that a public notice be made before the start of the public comment period and that sharing information must begin before the original version of the plan is formulated. In some cities, these are already institutionalized and running, so this is not an unfeasible action. This will prevent the public comment format from becoming overwhelming. In order to announce the public comment period in advance, it is necessary to carefully manage the planning process. The administration's administrative ability will be tried.

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Bio-Oil Production from the Pyrolysis of Blue-Green Algae for Sustainability Alternative Fuels

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Abstract
Pyrolysis experiments of blue-green algae (*Arthrospira platensis)* were carried out in a custom-built tube reactor to determine the pyrolysis conditions which was affected by the production of pyrolysis oil. The effects of process variables; the operating temperature (400-600°C), raw material federate (0.4-3.0 kg h^{-1}), particle size (150-800 µm) and N_2 flowing rate (50-250 cm^3 min^{-1}) were also investigated. The maximum bio-oil yield of 46.19 %wt. was obtained at process conditions of 500 °C feed rate of 0.6 kg h^{-1}, the N_2 flow rate of 200 cm^3 min^{-1} where using a feedstock by an average particle size of 500 µm. The oily and aqueous phase also were separated, the bio-oil yield was obtained, and their characteristics were investigated using GC-MS technique, and FT-IR also was confirmed the functional group of bio-oil which acquired of phenol, amide and carboxylic acid. The physicochemical analysis shows that bio-oils that have a higher calorific value of 29.12 $MJkg^{-1}$ are promising alternative fuels, whereas the high level of acidity of 46.78 mg_{KOH}/g required an upgrading before used as a fuels

Keywords: pyrolysis, bio-oil, Spirulina

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Introduction

During the last few decades, the depletion of the reserved conventional fossil fuels where the energy consumption had continuously been increasing, energy price crisis, the dramatical increase of CO_2 emission and raising awareness of global warming has drawn more has encouraged the interest in alternative sources on the predictions of bioenergy (Lee, et al., 2010; Lie, et al., 2012; Plis, et al., 2015; Anand, et al., 2016). Biomass is one of the most preferred sources of sustainable energy with the properties similar to fossil fuels depend on its characteristics and their conversion processes into bioenergy (Lee, et al., 2010; Duman, et al., 2011; Aysu et al., 2014). Biomass including lignocellulosic, wood, and algae that a potential candidate to produce clean fuels (Moralı, et al.,2015) Nevertheless, biomass is particularly prominent in that it not only enhances fuels diversification but also mitigates the environmental pollution and global warming due to the emission of carbon dioxide neutral (Charusiri, et al., 2017).

Algae have proven to be a viable biomass feedstock for conversion to fuel intermediates due to their high energy content and ability to grow autotrophically using carbon dioxide and sunlight. Also, algae's high biomass yield and ability to accumulate large quantities of neutral lipid and protein that promising as a source of energy production (Thangalazhy-Gopakuma, et al., 2012; Hsieh, et al., 2014) Currently, conventional algae have been considered for use as a bioenergy resource for biofuel production either biochemical sub derided into trans-esterification for biodiesel production has been accessible in the past ten years (Hu, et al., 2013). However, one limitation of this production of biodiesel is the use of many chemicals and produces waste from many production processes such as wastewater and chemical residues. However, the thermochemical conversion process such as pyrolysis is among the most promising methods for producing liquid fuels from algae can be attained both thermal and catalytic conversion in which algae is decomposed by thermal on the absence of oxygen atmospheric, to obtained of char, gaseous, bio-oil, and its value chemicals (Lie, et al., 2012; Cao, et al., 2013; Wang, et al., 2013; Yan, et al., 2017). In slow and fast pyrolysis was mainly a difference in the amount of products, on slow reaction gave char production maximized whereas fast pyrolysis gave bio-oil as mostly liquid products is one most valuable chemicals (Duman, et al., 2011).

In this study, *Arthrospira platensis* (*Spirulina platensis*), commonly known as spirulina, is among the most popular blue-green algae species, which is cultivated on a large scale (Chaiwong, et al., 2013; Anand, et al., 2016) This species is primarily utilized for the production of bio-nutrients and food supplements. Nevertheless, it has been considered for use as a bioenergy resource for biofuel production either biochemical sub derided into trans-esterification or thermochemical via fast pyrolysis reaction. to produced bio-oil. The emphasized of this study to optimization the operating parameters of pyrolysis bio-oil production from Spirulina in small pyrolyzer. Also, the analysis by the gas chromatography-mass spectrometry to understand the composition of chemical constituents formed during pyrolysis studies. Product yield, the composition of bio-oil and tar phase and the most relevant physicochemical properties also were obtained.

Materials and Methods

Arthrospira platensis (Spirulina algae) was collected, then dried in open air for seven days and sieved by a Retsch AS200 sieved shaker according to ASTM E11 to classified into desire sizing of feedstock about of the three series average size including below 250 µm, 500 µm and 750 µm. The proximate analysis included the measurement of moisture, volatile matter and ash content were determined to investigate according to ASTM E-871-82, ASTM E-872, and ASTM E-1755-01, respectively. The ultimate analysis was performed using CHN-600 analyzer (LECO, USA.) to carried out, the carbon, hydrogen, and nitrogen content. Heating value and bio-oil product were obtained following ASTM D2015 using a LECO AC350 (LECO, USA.). Thermal gravimetric analyzer Netzch 409 Simultaneous STA (NETZSCH-Geratebau GmbH, Selb, Germany) was used examine the thermal decomposition behavior of Spirulina and to provide a reference for operational parameters.

The pyrolysis of Spirulina was performed in custom-built stainless steel (SS316) that illustrated in Figure 1. Spirulina was contained in the biomass hopper and fed into the pyrolyzer by under-screw feeder with a nitrogen gases flow rate of 50-250 cm^3min^{-1}. The temperature of pyrolysis was explored under 400 to 600 °C. Reactor screw feeder controlled the detention time at a feeding rate of 120 to 240 rpm represented of detention time of 0.5 – 2.5 kg h^{-1}. The higher speed (rpm) cause the lower detention time and conversely. Furthermore, the average particle size also determined by ranging from 100 – 1000 µm. After the reaction, the yield of bio-oil, non-condensable gas and bio-char also were calculated.

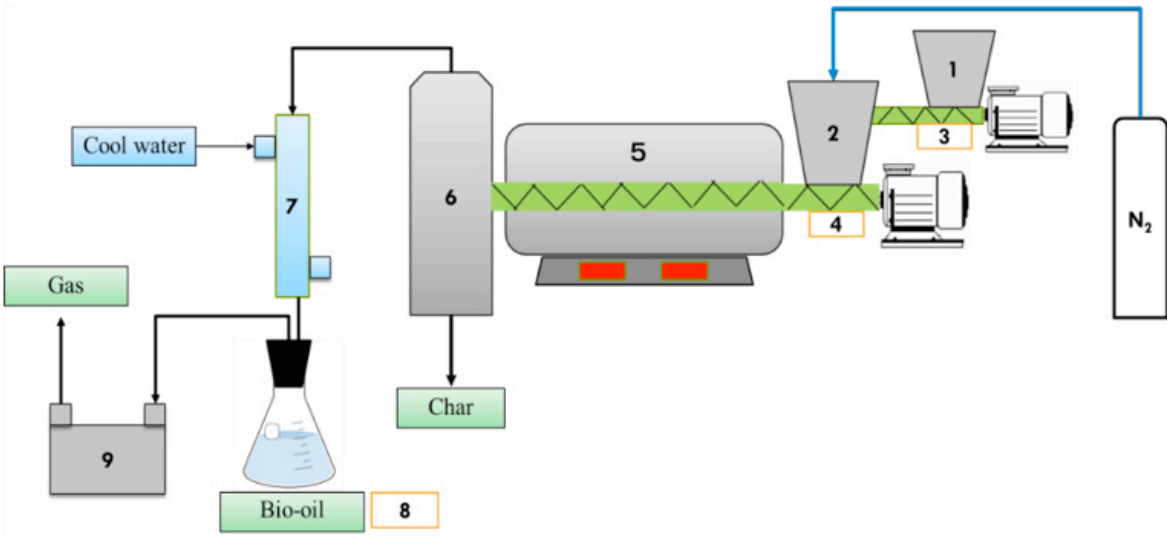

Figure 1. Schematic diagram of the pyrolysis reaction (❶biomass hopper ❷the 2nd hopper ❸screwing feeder ❹under-screw feeder ❺a custom-built tube pyrolysis reactor ❻cyclone ❼ooling condenser ❽bio-oil collector ❾gas hopper

Pyrolysis oil products are usually very complicated mixtures with organic and aqueous phases. A liquid pyrolysis oil phases were separated and analyzed with an Agilent 7890B/5977A (Agilent, USA) GC-mass spectrometer (MS) equipped with

both a flame ionization detector (FID), and a thermal conductivity detector (TCD), a split/splitless injection unit and an HP-5MS capillary column (30 m x 0.25 mm x 0.25 μm). The chemical constituents were identified by comparison with the MS database in the National Institute of Standard and Technology (NIST) library. The physicochemical properties of the pyrolysis oil obtained from Spirulina pyrolysis were determined according to the ASTM standard as follows: density, kinematic viscosity, and HHV according to ASTM D369, ASTM D445, and ASTM D240, respectively. The modification acid number (MAN) was determined using an 840-Trinoplus automated titration (Metrohm, UK) according to ASTM D664, and the ultimate components of pyrolysis oil from the Spirulina were determined using a LECO CHN-200 (LECO, USA). The peaks identified in the GC-MS confirmed the identities of the chemical compounds.The ultimate analyses and physicochemical property determination revealed that the properties of the algae pyrosis oil for use to the sustainable energy and its value chemicals.

Result and Discussion

Table 1. illustrated the analyses of proximate and ultimate of Spirulina algae, as can see in the table, high amounts of volatile matter led to easier decomposition of the biomass during the pyrolysis reaction. Moreover, Spirulina of highly volatile matter has preferential properties for its application in the pyrolyzer. The proximate analysis showed that the volatile matter content of Spirulina is also higher whereas the fixed carbon and ash are lower and lower than the comparison with the several lignocellulosic biomass (Chaiwong, et al., 2013, Anand, et al., 2016). The ultimate analysis shows that Spirulina was found to have a high carbon content of 26.36 %wt. on a dry basis and the content of H/C ration and O/C ratio were quite different to the other algae. Also the nitrogen content of 5.84 %wt. was higher for the sample due to the protein component.

Table 1. Proximate and ultimate analysis of Spirulina algae

Proximate analysis	
Moisture (% wt.)	8.84
Volatile matter (% wt.)	78.74
Ash (% wt.)	7.39
Fixed carbon (% wt.) by different	5.03
Ultimate analysis	
Carbon (% wt.)	26.36
Hydrogen (% wt.)	4.82
Nitrogen (% wt.)	5.84
Oxygen (% wt.) by different	18.27
H/C ratio	2.19
O/C ratio	0.52
Composition	
Cellulose (% wt.)	5.10 ± .92
Hemicellulose (% wt.)	1.381 ± .23
Carbohydrate (% wt.)	20.46
Protein (% wt.)	63.65
Lipid (% wt.)	6.18

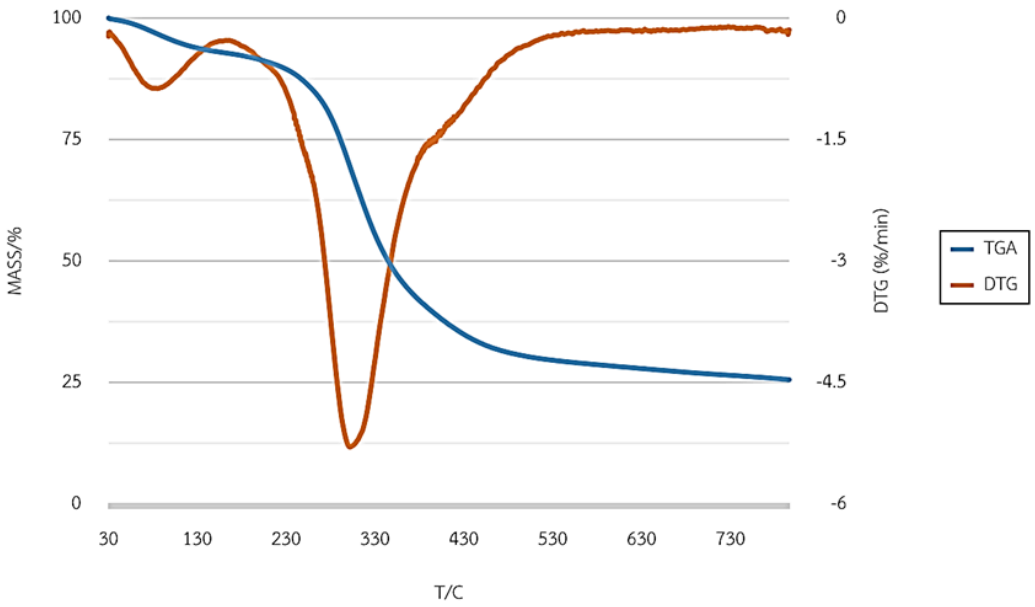

Figure 2. TG-DTG of the degradation process of Spirulina at a heating rate of 10 K min^{-1}

Figure 2**.** illustrated that he thermogravimatric analysis of Spirulina at the heating rate of 10 K min^{-1} in the N_2 atmosphere **(**feeding rate of 50 cm^3min^{-1}**)**, the result shown that the thermal decomposition of algae was 3 stage; an initial to 108 °C is the moisture removal from the microalgae, the second step is the temperature of 250 °C is the devolatileization of volatile matter and some lipid, the final step is the carbon decomposition to char and ash at the temperature above of 550 °C**.** Nevertheless, the temperature decomposition of algae also highest at the temperature of 300 to 550 °C after this operating temperature**.**

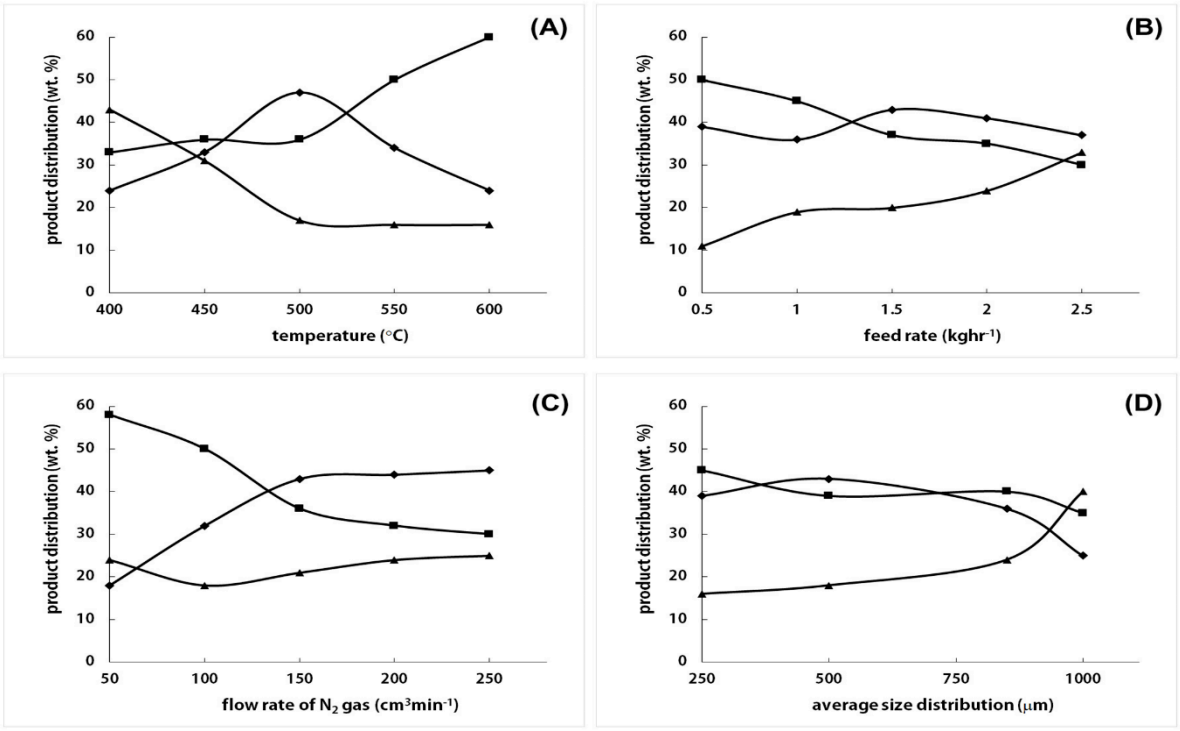

Figure 3. Product distribution of the pyrolysis of Spirulina [■ gas; ♦ bio-oil ;▲ bio-char]

Several studies of the influence of pyrolysis temperature on products distribution and obtained the likely results**.** To maximize high-grade bio-oil production from lignocellulosic biomass and algae, the following typically conditions consisted of rapid heating-up rate, moderate reaction temperature, and short residence time **(**Aysu. Et al., 2014: Moralı, et al., 2015; Charusiri, et al., 2017)

The effect of temperature

Figure 3**(**A**)** illustrates the effect of temperature on product distribution of the pyrolysis of Spirulina**.** At the higher temperature, the thermal degradation can still decompose the small gaseous components into incondensable gases, thus decreasing the bio-oil yield, although the temperature continued to increase over the optimal conditions **(**Lee, et al**.**, 2010; Aysu. Et al., 2014) The result reveals that a coupling of the high temperature and a high residence time with a slow biomass feed rate are the primary factors affecting the bio-oil conversion**.**

The effect of feed rate

The results demonstrated in Figure 3(B) shown that the Spirulina feed rate significantly influenced the bio-char yield. Whereas when the feed rate was increased, the biochar yield also gradually rose to a maximum bio-char yield. This observation also implied that the secondary reaction of volatile vapor and the thermal decomposition of tar were significant (Luo, et al., 2013; Aysu. Et al., 2014; Moralı et al., 2015) when the Spirulina feed rate was high. Additionally, low feed rates did not significantly affect the liquid bio-oil yield. Thus, the bio-oil was not formed entirely

from the primary and secondary reactions due to insufficient heat carriers and transfer for the volatile vapor decomposition reaction

The effect of the N_2 sweeping

As can see from Figure 3(C), the bio-oil yield increased with a long residence reaction time along with a low feedstock feed rate and low nitrogen sweeping gas flow rate. A higher nitrogen flow rate reduced the residence time, whereas an increasing temperature caused the decomposition of volatile matter, with the second pyrolysis reaction of more massive hydrocarbon compound after that converted to small hydrocarbon compound (Luo, et al., 2013); this process affected by thermal degradation

The effect of particle size distribution

The particle size of the algae feedstock subjected to the pyrolysis process is another parameter that affects the product distribution. Figure 3(D) represented the particle size affects the mass and heat transfer to the feedstock, the decomposition biomass, devolatilization to volatile vapors and the thermal decomposition of tar during the pyrolysis reaction. In addition, as the particle size increased, the pyrolysis of Spirulina mainly occurred on the algae surface, and the mass and heat transfers were affected by the average size distribution and uniformity and more significant to the liquid product than increasing the average particle size because the temperature inside may have been insufficient to complete the thermal decomposition reaction during the primary pyrolysis stage (Charusiri, et al., 2017).

Characterization of the pyrolysis bio-oil of Spirulina algae

The maximum bio-oil yield of 46.19 %wt. was obtained at process conditions of 500 °C feed rate of 0.6 kg h^{-1}, the N_2 flow rate of 200 cm^3 min^{-1} where using a feedstock by an average particle size of 500 µm. In order to quantify the compounds using a GC/MS technique, the bio-oil compositions were identified at several retention times, and the percentages of the peak area, chemical formulas, and molecular weights are listed in Table 2. The organic compounds were analyzed and classified mostly of phenol, aliphatic hydrocarbon including decane, pentadecane, hexadecane as well, some carboxylic acid and oxygenate compounds and others. These chemical compounds were produced by the thermal decomposition of cellulose, hemicellulose and protein and lipid.

Table 2. Chemical compound in bio-oil fraction by Gas Chromatograph–Mass Spectrometry

RT (min)	Peak area	Formula	Compound
3.685	2.27	C_6H_5OH	Phenol
4.435	1.64	C_7H_8O	p-Cresol
5.15	1.16	$C_8H_{10}O$	Phenol, 4-ethyl-
5.757	0.9	C_9H_9N	Benzenpropaneitrile
6.152	2.7	C_8H_7N	Indole
6.516	2.12	$C_8H_{10}O_3$	Phenol, 2,6-dimethoxy-
6.603	0.97	$C_{13}H_{16}$	Benzene, 1-methyl-4-[(1-methylethylidene]cyclopropyl]-
6.793	1.13	C_9H_9N	1H-Indole, 3-methyl-
7.144	1.43	$C_9H_{12}O_3$	1,2,3-Trimethoxybenzene
7.183	1.14	$C_{10}H_{12}O_2$	trans-Isoeugenol
7.426	1.09	$C_{15}H_{32}$	Pentadecane
7.647	1.38	$C_9H_{10}O_4$	Ethanone, 1-(2,6-dihydroxy-4-methoxyphenyl)
7.699	1.18	$C_7H_6O_3$	Benzaldehyde, 2,4-dihydroxy
7.786	1.65	$C_{11}H_{16}O_2$	2(4H)-Benzofuranone, 5,6,7,7a-tetrahydro-4,4,7a-trimethyl
7.92	1.81	$C_{11}H_{17}NO$	2-Cyclohexen-1-one, 2-methyl-5-(1-methylethenyl)-, O-methyloxime, (+)-
8.519	1.17	$C_{21}H_{29}NO_5$	1-Ethylamino-3-(2-methoxy-4-methyl-phenoxy)-propan-2-ol
8.61	11.34	$C_{17}H_{36}$	Heptadecane
8.644	1.01	$C_8H_{10}S$	Benzene, 1-methyl-4-(methylthio)-
8.931	1.04	$C_{13}H_{20}O_2$	Olivetol, dimethyl ether
9.373	8.49	$C_{18}H_{36}$	9-Octadecyne
9.407	1.27	$C_{20}H_{40}$	2-Hexadecene, 2,6,10,14-tetramethyl-

RT (min)	Peak area	Formula	Compound
9.503	0.93	$C_{20}H_{40}O$	3,7,11,15-Tetramethyl-2-hexadecen-1-ol
9.598	3.77	$C_{16}H_{32}O$	Hexadecanal
9.707	3.1	$C_{15}H_{29}N$	Pentadecanenitrile
9.893	1.38	$C_{16}H_{30}O_2$	Palmitoleic acid
9.993	17.2	$C_{16}H_{32}O_2$	n-Hexadecanoic acid
10.582	1.16	$C_{14}H_{24}O$	2(1H)-Naphthalenone
10.734	1.1	$C_{20}H_{40}O$	Phytol
10.764	1.95	$C_{18}H_{30}O_2$	Gamolenic Acid
10.821	6.12	$C_{18}H_{32}O_2$	9,12-Octadecadienoic acid (Z,Z)-
10.933	1.2	$C_{18}H_{36}O_2$	Octadecanoic acid
10.968	1.14	$C_{18}H_{35}NO$	9-Octadecenamide, (Z)-
11.046	7.04	$C_{16}H_{33}NO$	Hexadecanamide
11.831	2.43	$C_{18}H_{32}O_2$	Methyl 9,12-heptadecadienoate
12.425	3.52	$C_{19}H_{38}O_4$	Glycerol 1-palmitate

Table 3. Ultimate analyses of pyrolyzed product

Composition	Aqueous phase	Bio-oil phase	Bio-char
Carbon (% wt.)	1.17	4.93	5.47
Hydrogen (% wt.)	11.62	11.47	4.46
Nitrogen (% wt.)	0.43	0.66	0.74
Oxygen* (% wt.)	4.27	1.26	3.07
H/C ratio**	9.94	2.33	0.82
O/C ratio**	3.65	0.26	0.56

*by different
** by calculation

The physicochemical properties of the pyrolysis oil are presented in Table 3 and Table 4**.** The elemental analyses revealed that the H/C and O/C values are lower than those of the algae feedstock**.** The thermal decomposition and gasification reaction formed a condensable bio**-**oil product, and CO and CO_2 were removed from the first stage of the thermal decomposition of the algae feedstock**.** The HHV of pyrolysis oil was between 29**.**12 $MJkg^{-1}$ As mentioned above, the HHV of the pyrolysis oil also increased after the pyrolysis process, potentially due to the significant influences of the temperature and residence time on moisture removal and the dehydration, devolatilization, and depolymerization reactions that condense the volatile vapors into the pyrolysis bio**-**oil**.** The density **(**1008**.**7 kgm^{-3}**)** and kinematic viscosity **(**4**.**13 mm^2s^{-1}**)** were measured using ASTM D369 and ASTM D445, respectively**.** Whereas the high level of the modification acid number of 46.78 mg_{KOH}/g according to ASTM D664 also determined investigate**.**

Table 4. Physicochemical analyses on pyrolyzed product

Physicochemical analysis	Bio-oil from Spirulina
Density @15 °C (kg/m^3)	1008.7
Kinematic @ 40 °C (mm^2/s)	4.13
Ash (% wt.)	0.68
Total solid (% wt.)	0.007
Acidity (mgKOH/g)	46.78

Conclusion

The pyrolysis of Spirulina algae under the custom-built pyrolysis reactor obtained the optimum reaction condition of the maximum bio-oil product yield of 49.19 %wt. was obtained at a final temperature of 500 °C, the feeding rate of biomass 200 rpm at a nitrogen gas flow rate of 200 cm^3min^{-1} and using the raw material at the average particle size of 750 μm. The GC/MS results, confirmed the bio-oil contain complex compounds mostly composed of aromatic, aliphatic hydrocarbon including decane and pentadecane and hexadecane as well, some acid and oxygenated compounds. The physicochemical properties of bio-oil shown the heating value and the acidity which were not suitable to direct used as transportation fuels substitution unless it is upgraded through catalytic cracking and hydrogenation similar to petroleum diesel fuel.

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Managing to Reduce the Risk of Mango Harvest and to Make the Value of Integrated Agro-Tourism: A Case Study of Mango Orchard Entrepreneurs in Chachoengsao, Thailand

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Abstract
Mango is a kind of fruit which can be planted all over the world including Thailand, and Chachoengsao is one of five provinces where mangoes are planted the most in Thailand as the soil in those areas are suitable for planting mangoes. The objectives of this research were 1) to study the body of knowledge and the model of harvesting mangoes by mango agriculturists in Chachoengsao, and 2) to study guidelines for developing agro-tourism of mango agriculturists in Chachoengsao. Data was collected from mango agriculturists in Chachoengsao, using questionnaires, and interviews of sample group. The research findings were that the current planting of mangoes has been changed from growing the mangoes from seeds, to grafted mango trees that grow and produce faster than by seeds. In terms of harvesting, the labour force is mainly needed for small orchards as picking mango fruit is done by hand. However, for fruit on higher branches, some harvesting aids had to be employed such as a basket 'Takraw' which is used to assist in picking. Moreover, separating planting zones, and growing a variety of mangoes are to help insure mango fruit throughout the year. In terms of guidelines for developing agro-tourism of mango agriculturists in Chachoengsao, there was an agro-operation between mango agriculturists and government agencies of Khlong Khuean District to create agro-tourism in the community. The trip included visiting mango orchards and taking a boat trip to enjoy mangrove sightseeing along the Bangpakong River.

Keywords: Mango, harvesting mango fruits, agro-tourism

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Introduction

Chachoengsao has been a significant area in terms of agricultural growth as this area is enriched with biological diversity, abundant natural resources, and local wisdom beneficial for sustainable development, and spectacular natural, cultural, and historical attractions. The entire area consists of 3,344,375 rais (1,321,887.35 acres), and 60% of this area is used for agricultural purposes. The significant economic crops are mainly; rice, rubber trees, coconuts, and mangoes. The mango fruit has been planted in every district of the province consisting of; Bangkhla, Khlong Khuean, Ratchasan, Plaeng Yao, Phanom Sarakham, Sanam Chai Khet, and Tha Takiap. The popular mango fruit species in Chachoengsao include *Nam Dok Mai*, and *Khiao Sa Woey*. The area that grows the "delicious" mango species is planted mainly in the Bangkhla and Khlong Khuean areas. As fresh water, brackish water, and salt water pass through those areas, the soil is filled with minerals suitable for growing tasty mangoes. Currently, a request for Geographical Indication (GI) of Nam Dok Mai Si Thong mango variety and coconut of Sao Cha Ngok Sub-district, Bangkhla District is in the process (Deputy of Chief Commercial Officer, 2016). Exports of mangoes from Chachoengsao earn approximately one billion baht a year, with especially high sales in Asia such as Japan, China, and South Korea, due to its quality, good taste, and reasonable price (Samawattanasak, 2017). In the agricultural aspect, the growing crops system should be developed in accordance with the potentiality of that area, following the sufficiency economy laid out by the Former King of Thailand, Rama 9. In addition, the network of learning and developing better quality and standards should be established, making use of the supported research and development, as well as the local wisdom explicitly held. In terms of tourism, the tourist attractions should be managed systematically to engage the people and participate in local tourism management. The new model of tour activities should be developed to be consistent with the natural and cultural potential of the area (National Research Council of Thailand, 2012). Nevertheless, problems remain in the growing of mango trees, especially in the districts of Bangkhla and Khlong Khuean Districts which have to be at high risk of flooding, as those areas are wetlands, increasing the likelihood of floods that destroy the crops. When the local agriculturists have encounter this problem; they have to plant again, and wait for the new crop 3-4 years later, so the agriculturists tend to reduce the areas for growing mango trees. However, the agriculturists who have plenty of areas are sometimes unable to harvest the crops in time, thus losing their crops along with their income. Therefore, the researcher would like to investigate how to harvest crops wisely and integrate harvesting with agro-tourism kept firmly in mind.

Methodology

This research was conducted using mixed methods of quantitative and qualitative research. The objectives were: 1) to study the body of knowledge and the model for the harvesting of mangoes by mango agriculturists in Chachoengsao, 2) to study guidelines for developing mango agro-tourism by the agriculturists in Chachoengsao. The research population was composed of mango orchard entrepreneurs in Chachoengsao, who have emphasized on Good Agriculture Practice (GAP), members of The Mango Export Community Enterprise Bangkhla District and Mango Agriculturist Cooperative in Chachoengsao Province, totalling 226 people. The sample group consisted mainly of 145 people for the purpose of the quantitative

research (Yamane, 1967), and 30 orchard entrepreneurs for in depth interviews based on the educational purposes (Phothisita, 2006). The research instruments used for data collection were questionnaires, interviews, literary review, and information sources on the internet sites.

Results

The research showed that the mango fruits that had been grown using the grafted mango trees. First, use the *kalon* mango tree which is one of mango varieties in Thailand) as the rootstock, and attach the graft of mango varieties such as *Nam Dok Mai*, *Khiao Sa Woey*, and *Khai Tuek* on to the *Kalon*'s branch where they can join parts and the two plants, continue their growth together. *Kalon* mango tree is widely used as the rootstock because it is strong and resistant to environmental conditions. By this method, it can solve the problem of growing fruit trees from seeds which takes a very long time to bear fruit. The mango trees were planted at 3 x 3 meters in order for the mangoes to harvest more easily. By the use of the grafting technique, it took 3-4 years to bear fruits while it took more than 5 years growing from seeds.

According to the primary data collected by the Office of Chachoengsao Agricultural Extension (2017), regarding growing mango fruits in the entire area of 12,452.75 rais (4,922.04 acres), Bangkhla District had the most growing mango fruits totalling; 6,223.44 rais (2,459.86 acres), Khlong Khuean District; 2,294 rais (906.72 acres), and Ratchasan District had 1,479.88 rais (584.93 acres), respectively. And a total of 2,603 mango agriculturalists, and they had average 4.78 rais (1.89 acres) of growing mango fruits per person. The total areas which yielded the products were 10,615.99 rais (4,196.04 acres). The total yielded products were 5,236.666 tons. The average overall products were 523.25 kilograms per rai (0.395 acres). Bangkhla District yielded the most, totalling 1,590.809 tons, Ratchasan District yielded 10,615.99 tons, and Khlong Khuean District yielded 869.42 tons. In terms of yield per rai, Sanam Chai Khet District yielded the most, totalling 1,003.21 kilograms per rai, Tha Takiap District, Phanom Sarakham District, Ratchasan District, and Plaeng Yao District yielded 848.22, 768.27, 740.92, and 582.76 kilograms per rai respectively, which were higher than the average overall products. The other districts yielded lower than the average overall product shown as follows:

Table 1 Growing mangoes by agriculturists in Chachoengsao

No.	District	Mango Agri-culturists (persons)	Areas of Growing Mango Fruits (Rai)	Average Area of Possess-ion per Person	Areas of Yielded Products (Rai)	Products (Ton)	Average Products (Kilo-gram/rai)
1	Bangkhla	1,408	6,223.44	4.42	4,665.55	1,590.809	340.97
2	Khlong Khuean	448	2,294.00	5.12	2,042.45	869.420	425.68
3	Plaeng Yao	19	56.71	2.98	53.71	31.300	582.76
4	Mueang	363	938.24	2.58	933.24	444.485	476.28
5	Bang Pakong	16	24.12	1.51	24.12	3.370	139.72
6	Ban Pho	48	50.85	1.06	50.85	23.110	454.47
7	Phanom Sarakham	41	418.21	10.20	412.21	316.690	768.27

8	Ratchasan	158	1,479.88	9.37	1,466.56	1,086.600	740.92
9	Sanam Chai Khet	38	516.97	13.60	516.97	518.630	1,003.21
10	Tha Takiap	32	394.25	12.32	394.25	334.410	848.22
11	Bang Nam Priaw	32	56.08	1.75	56.08	17.842	318.15
	Total	2,603	12,452.75	4.78	10,615.99	5,236.666	523.25

Note: 1 Rai = 0.395256916996 Acres

In terms of harvesting mango fruits, as in Bangkhla, Khlong Khuean, and Mueang District, the mango orchards were found to have furrows, but mango orchards without furrows were found in other districts. However, the planted mangoes were closely placed in both kinds of orchards in order to harvest more easily. Thus picking mango fruits was done by hand for the small orchards not more than 20 rais (7.91 acres). Most of agriculturists in Khlong Khuean Districts possessed not more than 20 rais (7.91 acres). As for the big orchards with more than 20 – 500 rais (7.91 – 197.63 acres) in other districts, picking mango fruits was also done by hand but made use harvesting aids such as; a basket 'Takraw', aiding the labour force by allowing them to pick in the fruit from the orchards easily. But with larger orchards from 500 – 5000 rais (197.63 – 1,976.28 acres), picking mangoes was done not only by labour force and the 'Takraw' in addition to modern equipment. In this case, most mango agriculturists were also the leaders possessing the knowledge of production, the market mechanism and the knowhow to grow quality mangoes for export. These leaders tended to use technology in production and utilize Florigen (or flowering hormone) to grow mangoes. The flowering hormone was utilized every 15 days so as to aid the mango trees to bear fruit at different times of the year around every 6-7 months the orchards would yield a good harvest. In addition, some orchards were managed and used to attract tourists and sell a variety of mango species, as well as betel palms, and coconut trees (Kaewwongnukul, 2016 & Tanchiang, 2017) as follows:

No	Model	Method	Growing Area
1	Separating planting zones for big orchards	Using Florigen every 15 days – 2 months Picking by hand, Takraw, labour force, and equipment	> 500 – 5,000 Rais (> 197.63 – 1,976.28 acres)
2	Hiring labours or selling all mango fruits within the orchard	Picking by hand, Takraw, labour force, and middleman	> 20-500 Rais (> 7.91 – 197.63 acres)
3	Self-management by mango entrepreneurs for small orchards, not more than 20 rais (7.91 acres)	Picking by hand, and Takraw	1-20 Rais (0.395 - 7.91 acres)
4	Opening as agricultural tourist attractions	Selling the products to tourists	Every area in all sizes

In terms of agricultural tourism, the study found that Khlong Khuean District together with local government agencies arranged the agricultural tourism initiative to use bicycles to visit the mango orchards where the quality mangoes were grown for export. These mango orchards were also used as a demonstration center to share

knowledge of agriculture including planting, layering, and grafting. In addition, the agricultural crops and products were provided for tourists to buy. In addition to the bicycle tours, if the tourist group is very big, then the farmer's truck or "*Rot I Tan*" is provided to take tourists around to enjoy some sightseeing in the community and mango orchards where awarded with a prize for best quality mangoes, herbal garden, and sufficiency economy center (Rattanasin, 2017, Somboon, 2017 & Tanchiang, 2017).

From the studies on agricultural tourism in Khlong Khuean District, it was found that there were advantages of visiting mango orchards by bicycles as there was no pollution and saving energy. Tourists can enjoy nature and mango orchards up close. If tourists come in a large group which was recommended to contact Khlong Khuean Sub-District Administration Organization or Khlong Khuean District Office, as the modified farmer's trucks called "*Rot I Tan*" will be provided for the tourist group. Moreover, the agricultural demonstration center, herb garden, sufficiency economy center, and other tourist attractions are also provided. Tourists can travel on a one-day trip or spend the night in Chachoengsao, which has as many places of accommodation in the area. Interestingly, the researcher found another route worthy of travel; the Bangpakong River boat trip, where tourists can enjoy nature and sightseeing of Nypa palms, Cork trees, Mangrove trees along both sides of the Bangpakong River. Important to note: The mango orchards here having a World-Class reputation for growing "tasty and delicious mangos" are grown. Tourists can visit a variety of temples along the river and enjoy the route taken by boat for sightseeing in Khlong Khuean District, and along the Bangpakong River to the exit into The Gulf of Thailand. During November – December each year, dolphins come to this place to eat the school of coral catfish found that time of the year, which tourists can see flocks of birds at Bird Island (125 rais or 49.41 acres). In the evening, tourists can be impressed by the beautiful sunset scene of the Gulf of Thailand. Additionally, if tourists want to go to any other tourist attraction; such as Bangsaen, Si Chang Island, Pattaya, or even to Ko Samet in Rayong, these options are also available to provide diversity in the tour (Maitreewong, 2017).

Discussion

According to the results of this research, Bangkhla and Khlong Khuean District had a mango growing are, totalling 6,223.44 rais (2,459.86 acres), and 2,294 rais (906.72 acres), respectively, and were able to produce mango fruit weighing 1,590.809 tons, and 869.42 tons, respectively. The average product per rai (0.395 acres) is 340.97 kilograms, and 425.68 kilograms, respectively, which is lower than the average product of 523.25 kilograms per rai overall. On the contrary, the growing areas in the district of Sanam Chai Khet, Tha Takiab, Phanom Sarakham, Ratchasan and Plaeng Yao where the mangoes have been grown in orchards without furrows, and in higher lands that are far from water sources or the Bangpakong River, their overall areas for growing mangoes was less than that of Bangkhla and Khlong Khuean District. But the average products were higher than every district, 1,003.21, 848.22, 768.27, 740.92, and 582.76, kilograms per rai respectively. After analysis, this might be from two causes. The first cause: different methods of growing mangoes. In Bangkhla and Khlong Khuean District, the mangoes were grown in the orchards with furrows for irrigation in the dry season, but are more difficult to manage with furrows. (Kaewwongnukul, 2015, 2016) 2The strength of growing by this method is that the

flesh is good and tasty. Unlike the mangoes from the orchards with furrows, the mangoes without furrows in Sanam Chai Khet, Tha Takiab, Phanom Sarakham, Ratchasan and Plaeng Yao are bigger in size, but the flesh and the taste are not so good. Second, Bangkhla and Khlong Khuean District have faced severe floods; once in 2011 and again in 2012, destroying the mango orchards forcing the agriculturists to start planting again. Consequently, not many orchards have yielded any product leaving the agriculturists to wait for 1 -2 years. In addition to this low yield, the area for growing mangoes; more than 100 rais (39.53 acres), are at risk of not being able to harvest in time. And, unfortunately, the harvest and the long holidays of Songkran Festival are in the same time period. So, it is difficult to seek labours as they return to their hometown. The agriculturists who have large growing areas are also the leaders of Community Enterprise and Cooperative and tend to utilize Florigen to grow mangoes in order to aid the mango trees to bear fruit at different times of the year around every 6-7 months the orchards would yield a good harvest (Kaewwongnukul, 2017). The mangoes in many varieties, both ripe and unripe mangoes have been grown and also other plants such as betel palms, coconuts, bananas, and various vegetables, the agriculturists can earn money all-year-round (Tanchiang, 2017). Moreover, the mango orchards can be used as the agricultural attractions including demonstration center, herb garden, sufficiency economy center to welcome the tourists who come to travel on a one-day trip or spend the night in Chachoengsao, which has as many places of accommodation in the area. In addition, the tourists can take a boat trip to enjoy nature and sightseeing along both sides of the Bangpakong River to the exit into the Gulf of Thailand. They can be impressed by the beautiful sunset scene of the Gulf of Thailand in the evening. Especially, during November – January each year, the tourists will have a great time to see dolphins which come to this place to eat the school of coral catfish (Maitreewong, 2017).

Conclusion

Most of mango agriculturists have grown mangoes in many varieties, both ripe and unripe mangoes, that it has been considered a local wisdom in accordance with the principle of High Risk High Return. Growing mangoes in many varieties can help reduce the risks as the products will be yielded at different times so it can be possible to harvest in time. Each year, 70 – 80 tons of mangoes are lost due to being unable to harvest in time (Kunawut, 2015, 2016) Most of the mango agriculturists have collected the fallen mangoes from the trees to make dried mango paste or "*Mamuang Kuan*", preserved mango, and have sold it at the orchard for 250 – 300 baht per kilogram. This is a good way to add value to the agricultural products. Additionally, mango agriculturists have joined in "the agro-tourism". Using their mango orchards to be demonstration centres to give knowledge of mangoes, it can naturally be added to the agro-tourism connecting local tourist attractions with sources of agriculture and tourism allowing both to thrive from each other.

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Examining Conflicts Over Land Acquisition and Ownership in The Dormaa Traditional Area, Ghana

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Abstract
In many parts of the world, land conflicts often show socio-political, cultural and economic difficulties in specific areas. In Ghana, land conflicts are ubiquitous largely because of its unique land tenure traditions and governance practices. These conflicts have seriously affected economic development. In some parts of the country, land dispute issues took nearly three decades to reach court judgments. The Dormaa traditional area, on which this paper focuses, has long been the food basket of Ghana, providing a considerable amount of food crops and poultry. The area shares boundary with Cote D'Ivoire and has a unique trans-border land tenure traditions. In this area, the outcome of land disputes are determined by traditional authorities, statutory institutions or/and trans-border land claims from Cote D'Ivoire. This paper examines land conflicts in this area by analyzing the field data and interviews with key informants. The results show that three major factors have triggered land related conflicts and litigations. These are (1) undocumented lands, (2) lack of awareness of land related laws, and (3) overlapping jurisdictions and mandates between state and traditional authorities. After discussing these with details, we recommend (1) citizens could be encouraged to document their lands (2) updating of land laws among lawyers and (3) creation of system to offer proper dialogues among stake holders.

Keywords: Land tenure, Land conflicts, Land rights and ownership

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1. Introduction

Land conflicts take various forms. They are related to inheritance, boundaries and land use (Boone, 2014). Some are associated with group invasions or evictions (Wehrmann, 2008). Conflicts over land access and ownership occur in villages due to insufficient information about land tenure systems (Kapfudzaruwa and Sowman, 2009). At family level, land conflict occurs when a family member sells a piece of the family land without consulting other members (FAO, 2002).

Also, external interventions have changed the value and existing balance of land ownership (Rulli et al., 2018; Ahmed, et al., 2017). The emphasis of many African countries on foreign direct investments (FDIs) in the agriculture sector has resulted in the sharp increase of farmland demands (Boamah, 2014). In particular, Ghana has become a prime destination for large-scale farmland investments (Schoneveld and German, 2014).

In Ghana, the customary land tenure system has caused insecurity and uncertainty in land related matters (Boni, 2008). For instance, customary authorities may engage in land transactions without informing or consulting with key stakeholders. Conflicts often erupted, especially when parcels of land had been transferred to outsiders by a chief or traditional leader (Adams and Turner, 2005). Ghana's national land policy aims to increase the security of land tenure by officially registering lands (Lands, 1999), but little has been done to consolidate efforts of various agencies and institutions that implement land policies (Asiama et al., 2017).

Despite the increasing land conflicts, previous studies have been limited. They tend to focus on some specific incidences that are related to large-scale civil strifes or politically motivated conflicts. To critically address land acquisition and ownership problems in Ghana, there is the need to understand how the land tenure system works. This study attempts to show this and also identify factors that trigger or exacerbate land conflicts.

2. Methodology

2.1. Study area

This study was conducted in the Dormaa Traditional Area (DTA), located in the Brong Ahafo Region, western part of Ghana (Agyare et al., 2014). The DTA has the area of about 2,047.28 km^2, and its economic activities are mainly agriculture (69%), forestry and fishery (12%), and other services like trading and hospitality (19%). Its population is about 210,660 people, of which 48.9% are males and 51.1% are females with the average literacy rate of 67.8% (Ghana Statistical Service, 2014) Among Ghana's 2,410 commercial poultry farms, 510 (21%) are located in the Brong Ahafo Region, 202 of them in the DTA (FAO, 2014). Traditional authorities have governed the majority of the traditional area under customary laws (Pande and Udry, 2005). Furthermore, the DTA shares its border with Cote D'Ivoire, and because of this, a lot of trans border trade and economic activities takes place.

2.2 . Data collection

This paper is mainly based on the data collected by semi-structured interviews that took place between April and May 2017. These interviews were conducted with four key informants who have in-depth knowledge about the land tenure system in the study area. The interview questions focused on factors that may trigger land related conflicts. These informants belong to (1) the Lands Commission (District Director), which represents government authority, (2) the Dormaa Customary Land Secretariat (Coordinator/Secretary), representing the traditional authority, and (3) the Office of the Administrator of Stool Lands (District Director), which liaise the government agency to the traditional authority, and (4) the *"Nso Nyame Ye"* Chambers (Chief Lawyer), a legal representative for citizens on land disputes.

3. Results

The interviews have revealed that three major factors influence land conflicts in the DTA: (1) undocumented land ownership, (2) lack of knowledge about land related laws, and (3) fragmented/overlapping of jurisdictions. In the following, we explain each factor with details.

3.1. Lack of documentation of land belonging to traditional authorities

In Ghana, the law on the registration of customary land transactions authorizes the Lands Commission to register the land. However, it is loosely observed (Lands, 1999). Traditional authorities thus do not feel obligated to register traditional stool lands at the Ghana Lands Commission.

In the study area, the Dormaa Stool Land Secretariat (DSLS) is responsible for keeping land records for the traditional authority. The Secretariat also arranges an alternative dispute resolution (ADR) for land disputes. It sets up a traditional court at the Queen Mother's Palace according to the customary law. From May 2006 to May 2017, for example, the Secretariat recorded about 72 land related cases at the traditional court. According to our informant at the Secretariat, one case may take from one to ten years to settle. The reasons behind this long process for resolution are largely due to (1) lack of cooperation among sub-chiefs, (2) lack of resource and finance, and (3) no historical written documents about land ownership as traditional land transactions were done orally.

The roles of sub-chiefs are important in land dispute resolution. The customary law requires them to represent the paramount chief of the traditional authority. They report the disbursement of stool land to the Dormaa Stool Land Secretariat for record keeping. However, our informant told us that some sub-chiefs do not report mainly because they fear that, by reporting, they will have to disclose the income and gratuity they received from land transactions. They know that the Secretariat is financed mostly from land transaction fees and land taxes on stool lands. The Secretariat has power to discharge them. In addition, the secretariat depends partly on the taxes collected from land users by

office of the administration of stool lands (OASL). Challenges such as insufficient collection of the ground taxes due to unwillingness of other stakeholder's cooperation indirectly affect the finances of the DSLS.

The history of land ownership in the Dormaa Traditional Area has been kept through oral stories among elders. Traditions established boundaries by using river courses, trees, hills and other natural landmarks. These landmarks often change. The DSLS mostly depends on oral stories that cause confusion due to inaccurate information it collected. It does not have reliable maps/plans that show boundaries of stool lands. Some unauthorized, old or inaccurate maps have exacerbated land conflicts and litigation between stools, skins and other land-owning groups (Lands, 1999).

3.2. Lack of knowledge and awareness on land related laws and regulations

The Office of the Administrator of Stool Lands (OASL) is responsible for the collection and disbursement of stool land under Article 267 of the 1992 Constitution. It has attempted to increase revenue from disbursement, expedite the survey process for farmlands, and assist in the establishment of customary land secretariats under the Land Administration Project. It also documents customary land issues to reduce conflicts in collaboration with chiefs.

Informants, two district directors of the OASL we interviewed pointed out that land conflicts often happened due to lack of cooperation from traditional authorities and some locals related to the chiefs. The jurisdiction and mandate of the OASL also overlaps with the traditional authorities and the district administration in tax mobilizations. Before the establishment of the Office, chiefs and sub-chiefs of the area had collected various forms of land tax for centuries. These taxes or tributes included drinks, cash, agricultural products, and gifts. After 1992, chiefs continued to receive these tributes from land users. Chiefs view that the Office of the Administrator has challenged their traditional authority as the trustees of the land. They also worry that eventually they may lose land revenue. The district administration also collects other form of property taxes from land users and to them, they see it as double taxation.

Some locals who are related to the paramount chief's family called "royals" do not pay taxes to the traditional authorities. The tradition says that as members of the royal family, their ancestors fought and in some case died to secure the stool land. As compensation, they have been exempted from traditional taxation. However, the Ghanaian law does not recognize this tradition, and ask these royal members to pay tax, leading to confrontation with the Office of Administrator of Stool Lands. The Office often asks the police to assist its tax collection activities.

Overlapping responsibilities for land boundary surveys have caused confusion and exacerbated land conflicts in the Dormaa Traditional Area. For example, the Town and Country Planning Department, the Lands Commission, and the District Administration have dealt with land transactions in this area. The District Administration has collected property taxes on land usage and ownership. The Town and Country Planning

Department have demarcated lands for city or town planning. The Lands Commission has kept records of land ownership. Some landowners and leases registered their lands at the Lands Commission while others have not registered at all. This inconsistency has partially led to the duplication of land sales, leading to overlapped land ownership.

The lead lawyer of the law firm, *"Nso Nyame Ye",* has long been involved in land disputes and litigation in the traditional area. He emphasized that the problem mainly lies in insufficient knowledge about land related laws. This is the case even among some legal practitioners. For example, on July 17, 2014, the Sunyani High Court ruled on the case, *Chadoma Co. Ltd v. Jacinta Soroya Namih and Owusu*. Judge Alexender Osei Tutu said, "the understanding of the legal regimes of land administration in the country was somewhat not known to some lawyers" (Osei, 2014). In this instance, the lawyers had less knowledge about Article 257 (2) of the 1992 Constitution. The defendant lawyers submitted to the court the Lands Commission Act of 1994 [Act 483] as evidence but the statute had been repealed by section 43 (1) of the Lands Commission Act of 2008 [Act 767] (Osei, 2014).

Also, according to this lawyer, lack of legal knowledge among the locals is one of the causes that triggered land conflicts in the DTA. Furthermore, the unwillingness of the locals to investigate land ownership and identify their real owner or caretaker before transaction has resulted to multiple ownership and conflicts.

3.3. Fragmented jurisdiction and mandate of state agencies responsible for land regulations

The Lands Commission manages public lands and lands vested in the President by the Constitution (GLAP, 2014). The Lands Commission also advises the government, local authorities and traditional authorities on land policy for development.

The ruling of the Sunyani High Court in April 2014 reminded the Lands Commission that it is against the law for the commission to manage stool lands to the President as compulsory acquisition of land. The Lands Commission sometimes allocates the stool land that has been entrusted by the President to a private entity without consulting the traditional authorities. This action has led to conflicts between the government authority and traditional chiefs. In *Chadoma Co. Ltd of Sunyani v. Jacinta Soroya Namih and Owusu*, the Lands Commission allocated land inherited by Soroya Nimih from her father to the Chadoma Co. Ltd. The case was to determine whether or not the disputed land was public land and whether or not Lands Commission has the mandate to allocate the disputed plot to the Chadoma Co. Ltd. In that ruling, the court ruled lands commission has no mandate to allocate the land. The Lands Commission is tasked by the Administration of Lands Acts, 1962 [Act 123] to manage public land. The misapplication of lands commission's mandate sometimes triggers land conflicts in the area.

The compulsory land acquisition power of the President may cause a considerable friction between the state and the indigenous land holding authorities (Kotey, 1998). In the court judgment of July 2014, the Sunyani high court judge ruled that customary lands

are entrusted with the President for the beneficial use of Ghanaian people. In practice, however, the President has misused this power by marginalizing the authority of traditional people. Quite often in the past, the customary landholders' rights to land management were deprived (Kasanga and Kotey, 2001).

Conclusion and Recommendations

It is imperative to better understand Ghana's complex tenure system and overlapping government jurisdictions over land in order to reduce land conflicts. In our field survey, we found that the Regional House of Chiefs or the National House of Chiefs can also be more effectively mobilized to find solutions to the conflicts. We also found it important to update the knowledge of land ownership and tenure systems among lawyers who often deal with land conflicts. At the community level, citizens could be encouraged to document their lands. The involvement of all stakeholders in education, training and social learning about traditional tenure systems as well as proper dialogues can also facilitate communal resolutions.

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Efficiency Analysis of Rice Farmers in the Upper East Region of Ghana

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Abstract
This paper examines the efficiency of two rice producer groups in Kassena–Nankana Municipality, the upper east region of Ghana. The first farmer group practices irrigation, and the second one engages in rain fed agriculture. Normally, Ghanaian farmers do not irrigate crops. The group received NGO support to build water reservoirs for irrigating community's farms. This research applied the Total Factor Productivity methodology to examine the level of efficiency between these two groups in the 2015-2016 cropping season. Regression analysis was used to establish the relationship between farmers' production and their inputs. Other social variables such as age, education, access to extension officers and years of farming experience were also compared with farmers' production to know their level of significance. The multi-stage sampling procedure was used to obtain 150 small-holder farmers. The mean efficiency estimate for farms under irrigation was 63% while that of rain fed was 36%. The results give evidence of inefficiency in rice production among rain fed farms. This implies that on average, irrigation farmers could reduce their farm inputs by 37% and still produce the current level of output. The factors that influenced farmers' efficiency were land size, labor, age, education and years of farming experience. Rice production could improve if younger farmers learn from the knowledge of experienced farmers.

Keywords: Total Factor Productivity, Efficiency, Rice Production, Kassena–Nankana Municipality, Ghana

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1. Introduction

Rice is one of the main staple foods in the upper east region of Ghana. This region is among the major producers of rice in the country, but has experienced a decline in the production of rice from 2008 to 2013 (Ministry of Food and Agriculture, 2014). This declining trend poses a threat to food security in the country. As one of major causes, local farmers in this region emphasized more frequent flooding incidences because of the upper river spillage from Bagre Dam in neighboring Burkina Faso. Although this spillage occurs annually, these farmers appeared to be convinced about this reason.

As an agricultural extension officer, Kofi Kyei investigated this area, but all flooded areas did not appear to be negatively affected. In fact, rice production in the northern and the upper west regions have increased. We then considered the scenario in which the Bagre Dam spillage might not be the major cause of the rice production decline. This paper, therefore, examines the causes of rice production decline in the upper east region.

2. Study Area

According to the 2010 Ghana population and housing census, Kassena-Nankana Municipality had the total population of 109,944, representing 10.5 percent of the upper east region. Males constitute about 49 percent. About 73 percent of them live in rural areas (Ghana Statistical Service, 2014). The municipality had about 19,790 households. The average household size in the municipality was 5.4 persons per household. Children constituted about 45 percent.

This study area is predominantly agricultural region. In 2010, about 83 percent was engaged in agriculture. In rural areas, 93.1 percent of households practiced agriculture whereas in urban areas, about 57 percent engaged in agriculture. More than 96 percent of these households were crop farmers who typically combined it with poultry (chicken) farming (Ghana Statistical Service, 2014). According to the 2017 Ghana agricultural productivity survey report, the upper east region had 109,905 rice farmers, of which more than 9,000 were in Kassena-Nankana Municipality (Ministry of Food and Agriculture, 2017).

3. Methodology

3.1. Samples

In order to better understand various conditions rice farmers faced in the upper east region, we collected the data through interviews and questionnaire surveys from practicing smallholder rice farmers in five communities of Kassena–Nankana Municipality. The multi-stage sampling procedure was used in selecting these five communities. In May and June 2016, we interviewed 75 smallholder rice farmers who had practiced irrigation agriculture to obtain input and output data for the 2015-2016 cropping season. In order to compare the efficiency and productivity of these farmers, we collected another group of 75 smallholder rice farmers who had engaged in rain fed rice farming at five communities. These five communities are Yogbania, Korania, Biu, Gaani and Bonia.

3.2. Total Factor Productivity

To determine the efficiencies of the two farmer groups, this study used the Total Factor Productivity (TFP) model. The Total Factor Productivity measures the extent to which farm inputs of production is efficiently used. Efficiency is determined by the ratio of useful aggregate output to aggregate inputs of production. The Total Factor Productivity model is given as $A = Y/X$. A is the total factor productivity or efficiency of the individual farmer. Y is aggregate output and X is the aggregate input of production. The aggregate output means the cost of a bag of rice by the total number of rice bags produced after harvest. Aggregate input means the total cost of seeds multiplied by the total cost of fertilizer and the total cost of labor.

3.3. Regression Analysis

The study then carried out a regression analysis to establish the relationship between farmers' production and their inputs. This helps determine how significant the inputs of production were on farmers production. Other social characteristics such as age, education, years of farming experience were also compared with the production to determine the level of significance.

4. Results and Discussion

4.1. Farmers Social Characteristics

Table 1 shows farmers' social characteristics in the study area. The average mean ages for both rain fed, and irrigation farmers were forty-seven and forty-eight years old. The average household size in the study area was ten persons, of which four were children. Most farmers were educated up to the junior high school level. Both farmer groups had limited access to extension service officers for the 2015-2016 cropping season. On average, farms in the study area received extension services for only twice in the year. Both farmer groups used three to four acres of land for rice cultivation. This means that most farmers engaged in rice farming for subsistence rather than business.

Farmers	Irrigation		Rain fed	
	Mean	S. D[1].	Mean	S. D.
Age	48	10.96	47	11.05
Land Size (acre)	4	2.08	3	2.23
Years of Land use	15	8.13	13	7.77
Household Size	10	5.56	10	6.22
Number of Children in Household	4	2.71	4	2.47
Household members engaged in farming	5	2.34	6	2.83
Number of hired labor engaged in farming	9	4.83	7	3.52
Years of Schooling	7	4.82	7	4.7
Extension service contact (number of times a year)	2	1.08	2	1.01

Table 1: Descriptive Statistics of Farmers Social Characteristics

Table 2 shows the quantity of rice produced by gender for the 2015-2016 cropping season. Male irrigation farmers produced 3,320 bags or 332,000 kg of rice whereas their female counterparts produced 658 bags or 65,800 kg of rice. At rain fed farms, males produced 2,458 bags or 245,800 kg of rice and females produced 897 bags or 89,700 kg of rice.

Female farmers in the study area could not increase their production due to insufficient labor force and lack of land access. Farm sizes were greatly influenced by the traditional land tenure system. Most of these lands were owned by men. Those women who owned the land had either inherited or received it as a gift from their husbands. Most land owners preferred to sell their lands to men. Customarily men can pay laborers, but woman cannot. Women also had limited time to spend in the farms due to their household chores and childcare responsibilities.

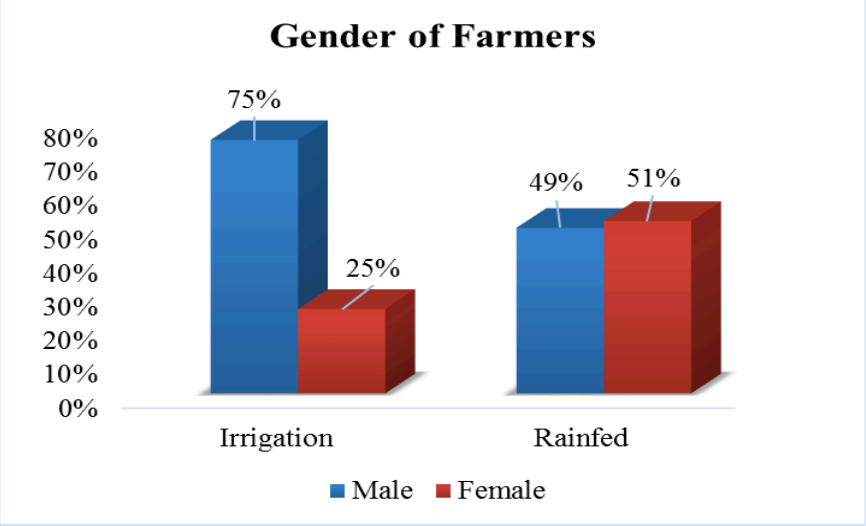

Figure 1: Gender of Farmers

[1] S.D. means Standard Deviation

Farmer	Male	Female	Total
Irrigation	332,000 kg	65,800 kg	397,800 kg
Rain fed	245,800 kg	89,700 kg	335,500 kg

Table 2: Quantity (Kg) of Rice Produced by Gender

4.2 Efficiency of Farmers

Table 3 shows that the mean efficiency estimate for the irrigation farms was 63% whereas that of rain fed ones was 37%. Irrigation farmers had higher efficiency because they received support from a non–governmental organization. Otherwise, irrigation in Ghana is very challenging largely because of inhibiting costs to establish and maintain the irrigation system.

Although these irrigation farmers produced more than rain fed farmers, this does not always mean that irrigation farmers receive more profits. As part of the agreement to receive irrigation support, these farmers must sell their products to this NGO association after every harvest. The association determines the price of rice by bag. Apart from building water reservoirs for farmers to do irrigation, the association supplies member farmers with seeds and fertilizers at a reduced cost. It also gives loans to their farmers at a lower interest rate with flexible payment plan.

Farmer	Efficiency
Irrigation	63%
Rain fed	37%

Table 3: Farmers Efficiency in Kassena–Nankana Municipality

4.3 Determinants of Rice Output

Table 4 shows the result of the regression analysis of farmers' input variables on production. It indicates that land and labor significantly affected the efficiency of the farmers. In particular, land (R squared = 0.764, Correlation = 0.874 and P value < 0.05) has the highest significance in determining the output of farms, followed by labor (R squared = 0.381, Correlation = 0.617 and P value < 0.05). This implies that relatively larger farms with more hired laborers were more efficient than those with smaller ones with less labor forces. The amount of applied fertilizer (R squared = 0.001, Correlation = 0.0316 and P value > 0.05) does not appear to have a significant impact on farmers' production.

Variable	R Squared	Correlation	P-Value
Land	0.764	0.874	1.13E-36
Labor	0.381	0.617	9.11E-06
Fertilizer	0.001	0.0316	0.915457

Table 4: Farm Input Variables of Farmers on Production

Table 5 shows the result of the regression analysis on farmers' social variables concerning production. It indicates that age, education and years of farming experience had a positive relationship with farmers' output at 5% level of significance. Though these three social variables are not very strong statistically, they did influence the output. The implication is that more experienced farmers tend to be more efficient than those with less experience. This suggests that rice production efficiency in Kassena-Nankana Municipality could increase if younger farmers learn from experienced farmers. On the other hand, the number of times extension officers visit farms did not appear to have any positive effect on the output. Government agents from its agricultural extension service work under the Ministry of Food and Agriculture to provide new knowledge of agricultural practices to farmers. This result is contrary to the recent study published in *Science*, in which researchers found the good co-relation between personal initiative training and increase in profits (Campos et al., 2017).

Variable	R Squared	Correlation	P-Value
Age	0.063	0.2529	0.000724437
Years of Farming Experience	0.009	0.095	0.037858166
Extension Service Contact	0.023	0.152	0.185035421
Education	0.010	0.1	2.55E-20

Table 5: Social Variables of Farmers on Production

Table 6 shows the equations to assess various variables on farmers' rice production to be used for the regression model. It shows that an increase in the size of land, laborers and education raise the productivity of the average farmer, thereby increasing efficiency. Although an increase in the amount of fertilizer applied decreases the productivity of the farmer, older farmers with more years of farming experience tends to maximize their productivity.

Variable (X)	Equation
Land	$Y = 11.36X + 8.621$
Labor	$Y = 4.044X + 16.28$
Fertilizer	$Y = -3.047X + 52.31$
Age	$Y = 0.640X + 18.43$
Farming Experience	$Y= 0.300X + 43.20$
Education	$Y = 0.599X + 44.59$
Extension service contact	$Y = 4.057X + 41.63$

Table 6: Regression Model Equations of Variables on Farmers' Production

5. Conclusion

This paper has analyzed the efficiency of two groups of rice producers in Kassena-Nankana Municipality. The estimated mean efficiency for farms under irrigation was 63% while that of rain fed was 36%. This implies that irrigation farmers could reduce their farm inputs by 37% and still come out with the same level of production. The regression analysis indicates that land size, age, labor, education and years of farming experience significantly influenced the efficiency of rice production.

There is the need for the Ghana government to invest in rural agricultural education. Even though extension service personnel did not appear to be helpful in increasing production so far, extension service has a good potential to help farmers by using its good networks with farmers. For example, the personnel can connect experienced farmers to younger farmers so that more young farmers can succeed and increase their productivity. Also, to increase productivity among women farmers, further policies are needed to strengthen women's land rights, childcare facilities and education opportunities.

Acknowledgements

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Qattara Depression and its Hydropower Potential

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Abstract
The Qattara Depression in Egypt has been suggested to be used for hydropower production. This paper investigates the possibility of having a Hydropower plant in this location to solve the current energy problem in the region, by providing the most updated results that would be used in such a project compared to previous studies. Hydrological elements affecting the water balance of the Qattara Depression region are studied, as by predicting the level of the water with time, the nature of the operation of the station can be chosen efficiently. Salinity concentration, evaporation rate of the formed lake, and the water channel formed that leads to the lake, and inward and outward seepage are all factors that had either been neglected in previous studies or not studied in the level of detail necessary for an accurate estimation of the lifetime, energy and economic feasibility of the plant. Metrological data obtained from weather stations surrounding the region were used in the calculations. Also we needed information about the nature of the region's soil and the hydraulic conductivity and studied the surrounding aquifers to obtain the best estimates when modelling the seepage values along with the years. The detailed calculation of the seepage and salinity have never been done and incorporated in the results making the results in this paper the most updated results. The results showed the lifetime of the Qattara Depression and the increase in the level of the water level with time.

Keywords: Qattara Depression; Hydropower; Energy

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Introduction

Qattara Depression was first investigated by Professor Ball in 1927. Table 1 shows information about the routs offered by Ball. By the 1950s after Ball's study and proposal the subject was reopened, were Siemens proposed a scheme that would have provided a power potential of 100 MW, with turbines only operating six hours per day (Martino, 1973). A commission led by Bassler in 1964 with results showing that the Qattara Depression, alternatively to what had previously been said, can be used for pumped-hydro-storage for peak load energy production. Bassler offered several configurations some including a canal that would deliver water to the depression as well as being a shipping route towards the Qattara Lake with a harbor and fishing grounds in the depression [Ezz El Din, 2004]. The depression was to be filled to a height of 60 m below sea level, which would correspond to an area of 12000 km^2. The volume removed due to evaporation would be 19000 million cubic meters annually. A flow of 600 m^3/s would be used for the compensation of the evaporation (Martino, 1973). The tunnels carrying the discharge would be about 80 km long and it would reach an underground power plant at level -54 m (Martino, 1973). The operation Bassler proposed was that during hours of low network load demand, the energy produced by the project turbines would be used to pump the water into a high-level natural reservoir that has a capacity of 50 million cubic meters (Martino, 1973). Water located in this zone would offer a valuable head during peak load hours. Therefore, during the peak load periods pumps would not be allowed to work and the extra head obtained would be able to generate a huge amount of power (Ezz El Din, 2004). This system would be able to produce 4000 MW during the peak period and would be adaptable to handle varying demand patterns [Ezz El Din, 2004]. The results of this paper would greatly help in choosing from the different options offered for operation of the Qattara Depression plant. Also Magdi Ragheb (Ragheb, 2012) proposed a power plant that would have wind turbines used in its operation by driving the pumps that would pump the water up to the storage reservoir. And his analysis showed that the plant could produce up to 1,500 MW (Ragheb, 2012).

But, what was lacking the previous studies is that they did not put in to the consideration the channel flow, the effect of salinity on the evaporation rate, and the outward seepage flow. Each of these factors would be investigated to understand their effect on the plant lifetime and operation. And having these results the best method of operation would be chosen.

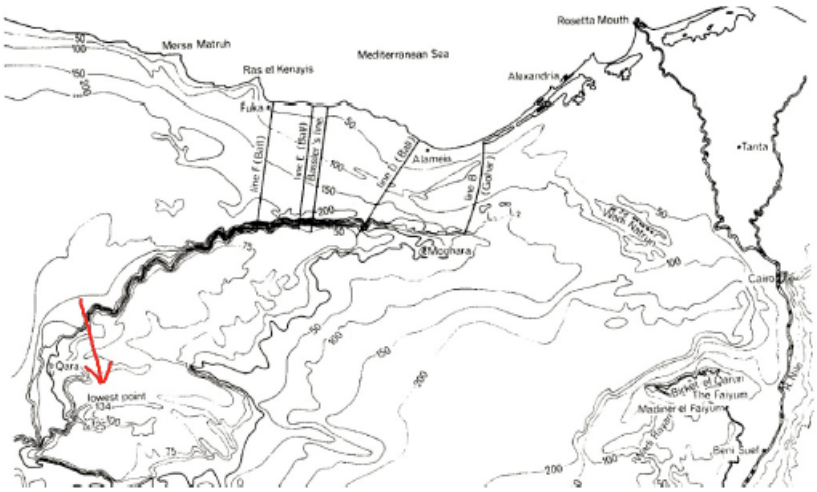

Figure 1: Qattara Depression (Martino, 1973)

Table 1: Routs offered by Dr. Ball

Routs	D	E	F
Lake level below sea-level (m)	50	60	70
Flow rate (m^3/sec)	656	546	348
Amounts of power developable (kwh)	200,000	200,000	150,000
Length of conduit from sea to contour (km)	72	76	80
Open channel from sea to tunnels (km)	20	———	———
Diameter of tunnels (m) for 200,000 kwh	12	11	———
Diameter of tunnels (m) for 175,000 kwh	11	10	———
Diameter of tunnels (m) for 150,000 kwh	10.3	9.5	9.2
Diameter of tunnels (m) for 125,000 kwh	9.8	9	8.2

Mathematical Model

Hydrology

Evaporation is one of many factors that affect the governing hydrological equation below:

$$\Delta S = \{P*A+Q_s+Q_{in}-Q_{out}-E*A\}*dt \quad (1)$$

Where:
ΔS=monthly change in storage (m^3)
P=monthly mean precipitation (m^3/day)
Q_s=monthly mean subsurface inflow (m^3/day)
Q_{in}=monthly mean discharge to be conveyed (m^3/day)
Q_{out}=monthly mean discharge to be pumped (m^3/day)
E=monthly mean evaporation rate from sea surface (m^3/day)
A=Qattara Depression surface area at corresponding level (m^2)
dt =Time interval equals a month

The subsurface inflow was estimated to be (Q_s) 57.5 million m3=year (Ezz El Din, 2004). While (Q_{out}) represents the discharge to be pumped back to the sea. The latter term was based on a proposal by Ezz El Din (Ezz El Din, 2004) to pump water from the depression back to the Mediterranean Sea since his calculations showed that the evaporation rate at some point is negligible due to the increase in salinity, this point will be investigated in details in this paper. This is in direct contrast to what Ball and Bassler deduced, which is that the evaporation would continue and would balance with the inflow. (Q_{out}t) is not considered by the author in his model due to its high cost, therefore the term is taken as zero. As will be shown, even the calculations produced in regards to the salinity by Ezz El Din where simple and a more detailed calculation would produce a less aggressive increase in salinity that would affect the evaporation rate and in turn the final level of the lake. Add to that the effect of the outward seepage to the final results.

Topography

A very important section in the model is the calculation of the area and the volume of the lake at each level in each time step. Topographic data about Qattara Depression is desperately needed for such a project. Data produced from the Shuttle Radar Topographic Mission elevation data product

(SRTM) was used in mapping Qattara Depression (Hafiez, 2014). The following procedure was followed to produce the volume and area of Qattara Depression at different altitudes which is necessary for our model. Using the SRTM data a digital elevation model (DEM) file is produced which is imported to Golden Software Surfer that produces the volume and surface area data at different levels (Hafiez, 2014). The below equations were produced and are used in our Model at each time step to obtain the area.

$$A = 117.5 * S.L + 1950 \qquad For\ (-40 \le S.L \le 0) \quad (2)$$

$$A = 0.0085 * S.L^4 + 2.1211 * S.L^3 + 188.6 * S.L^2 + 7286.7 * S.L + 118522 \qquad For\ (-90 \le S.L \le -40) \quad (3)$$

$$A = 463073 * e^{0.0682 * L} \qquad For\ (-120 \le S.L \le -90) \quad (4)$$

Where:
A = Total area of the Qattara Depression surface (m^2)
S.L= Surface level of the Qattara Depression (m)

Channel Flow

After examining the topography of the Qattara Depression it became clear that there was another factor that would affect the model which is the channel flow. As the area of the channel formed at the entrance of the sea water to the depression can be included in the evaporation calculation in addition to the area formed by the lake.

The slope at the borders of the depression is aggressive which would provide inertia for the seawater at the entrance. The study shows that the maximum width from north to south is 145 km at longitude 27_30'E (Hafiez, 2014). While the maximum length from east to west is 300 km at approximately latitude 29_45'N. The deepest point is at 134 below sea level. (Hafiez, 2014), and is located at the depression's western corner (29_23'33"N. latitude by 26_43'57"E. longitude) (Hafiez, 2014). In our model

the sea water flowing out of the turbines is assumed to follow a channel like flow towards the lowest point in the depression. Analysis of the topography of the depression indicates a slope of approximately 0.4 m/km. Moreover the terrain is assumed to have a manning coefficient n=0.035 based on comparison with similar terrains. The effect caused by this channel on the filling scenario has never been studied before. Manning's formula for channel flow was used as shown below.

$$Q = \frac{1}{n} * A * R\frac{2}{3} * \sqrt{S} \quad (5)$$

Where:
Q = Flow Rate, (m3/sec)
v = Velocity, (m/s)
A = Flow Area, (m2)
n = Manning's Roughness Coefficient
R = Hydraulic Radius, (m)
S = Channel Slope, (m/m)

$$R = \frac{A}{P} = \frac{b*h}{2h+b} \quad (6)$$

Therefore:

$$V = \frac{1}{n} * R^{\frac{2}{3}} * \sqrt{S} \quad (7)$$

From the topography obtained from Qattara Depression (h) can be considered in the range of 0.5 to 2 m, with (b) ranging from 378 to 3810 m. And in equation 6 b is the breadth h is the height and P is the perimeter. These values are used in the model to see if the channel would have an effect on the filling scenario and the evaporation rate and also to estimate the time the journey would take to reach the lowest point in the Qattara Depression, the latter was found to be of the order of 2 days.

Evaporation

An extensive study was done by Ezz El Din (Ezz El Din, 2004) who calculated the evaporation rate using Penman's equation (Peel, 2013) predicted the changes of the Qattara Depression surface level and analyzed the economics of the project at that time. Ezz El Din's usage of Penman's equation (Peel, 2013) was also incorporated in our Model, but the increase of salinity concentration is where our Model differs. There are many formulas available to be used for the estimation of evaporation. Most of them are based on Dalton's fundamental law, which states that evaporation will take place if the actual vapor pressure of the air above the water surface is less than the actual vapor pressure at the water surface. Penman's equation has given very good results especially in humid regions from all the regions that it has been checked around the world (Ezz El Din, 2004). Therefore this part was also used in our Model with confidence. Ezz El Din (Ezz El Din, 2004) modeled the change in the surface level with time using the meteorological data for 360 months (1970-2000). Once using the evaporation rates measured and once using the evaporation rates calculated using Penman's equation, the results showed that the equation is applicable to the monthly average. In Ezz El Din's model, each run had a random year chosen from the

30 years available. The same meteorological data was used in our Model. Different schemes where studied by Ezz El Din as shown below:

- Base-load scheme 24 hours production
- Peak-load scheme for some hours of production per day for developing hydro power during the peak load period
- Mixed pumped storage scheme which is used to develop the hydro power at peak-load period and pumping at the off-peak period, and the pumping power coming from the grid during off peak period

Ezz El Din concluded from his results of the three alternative schemes that salinity would have a severe effect on the lifetime of the project. As increasing the salinity will severely decrease the evaporation rate and lead to the water level increasing much more rapidly and not leveling out, as will be seen in the results, contrary to what Ball and Bassler deduced. Our model studied the effect of salinity in greater detail. The following form of Penman formula (Peel, 2013) is used in the model to obtain the evaporation rate in mm/day:

$$E = \frac{\Delta * H + \gamma * E_a}{\Delta + \gamma} \quad (8)$$

Where:
E= Evaporation in mm/day
Δ= The slope of vapor pressure vs temperature curve
E_a=Evaporation rate using Dalton's equation (Jensen, 2008) of the boundary layer above the water surface in mm/day
γ= psychomotor constant = 0.66 if temp in ℃ and e in millibar or 0.485 if e is in mm Hg.
Hence using equation (1) the variations in the monthly water storage are obtained but an important factor that needs to be studied is salinity and its effect on the plant's lifetime.

Salinity

The salinity would increase due to the sea water continuously pouring and evaporation occurring. This would lead to a decrease of the evaporation rate, which in turn would lead to a rise in water level and consequent decrease in head available and therefore power output and lifetime of the plant. Specific gravity of the sea water entering Qattara Depression (S.G) is taken as 1.025 as this represents the (S.G) of the Mediterranean Sea. Variations in the specific gravity of the Qattara Depression Lake (g_s), were considered in Ezz El Din's calculations using the general equation shown below:

$$S.G = \frac{\Delta S * g_s + V_o * S.G_O}{V_o + \Delta S} \quad (9)$$

Where:
$S.G_o$ = Initial value of specific gravity
V_o = Initial volume of sea water
g_s = The specific gravity for the differential volume
ΔS = Change in contents of water

The Equation used in Ezz El Din's model was found to be very approximate so for more accuracy in our model the following equations are used.

$$C = \frac{mass\ of\ salt}{volume\ of\ water} \tag{10}$$

Where:
C: Instantaneous salt concentration in reservoir

$$\delta C = \frac{dC}{dm_{salt}} * \delta m_{salt} + \frac{dC}{dV} * \delta V \tag{11}$$

$$\delta m_{salt} = [V_{sea} * C_{sea} + \sum V_{si} C_{si} - (V_{so} + V_{pumped})C] \tag{12}$$

$$\frac{dc}{dt} = \frac{1}{V}[V_{sea} * C_{sea} + \sum V_{si} C_{si} - (V_{so} + V_{pumped})C] - \frac{m_{salt}}{V^2}[V_{sea} + V_{rain} + \sum V_{si} - V_{so} - V_{evap} - V_{pump}] \tag{13}$$

Where:
$\frac{dc}{dt}$=Rate of change of salinity
V=Volume of water (m^3)
V_{sea}=Flow rate of sea water entering the depression (m^3/month)
C_{sea}=Salinity of the sea in kg/m^3
V_{si} =Flow rate of water entering the depression through seepage (m^3/month)
C_{si} =Salinity of the inward seepage in kg/m^3
V_{so} =Flow rate of water leaving the depression through seepage (m^3/month)
V_{pumped} =Flow rate of sea water pumped out of the depression (m^3/month)
C=Salinity kg/m^3
m_{salt} =Mass of salt in kg
V_{rain} =Flow rate of water entering the depression through rain (m_3=month)
Vevap =Flow rate of water leaving the depression through evaporation (m3=month)

The predictor corrector method is then used in matlab for equation to obtain accurate values for the salinity (C) in every time step which is then converted to specific gravity to find the effect of salinity on the evaporation rate. The evaporation factor is derived as shown below. This factor is multiplied in the model to the value of evaporation calculated and it can reach zero if the salinity of the water reaches a certain threshold. Es represents the value of evaporation at the salinity reached.

$$\frac{E_s}{E_o} = 8.23 * S.G^2 - 32.5 * S.G^2 + 39.8 * S.G - 14.5 \tag{14}$$

$$\frac{E_s}{E_o} = 5.6 * S.G^2 - 16.58 * S.G + 12.273 \tag{15}$$

Seepage

Seepage is also another very important factor that was neglected in all previous studies. This is a factor that when included in the calculation was assumed by all previous studies to have a positive effect on the plant life, which is true. But, that positive impact needs to be calculated as it would affect the economic study of such a

project significantly. Dr. Fredlund (Fredlund, 2001) presents a three dimensional partial differential equation for seepage through a heterogenous, anisotropic, saturated-unsaturated soil and satisfies conservation of mass for a representative elemental volume. The equation shown below assumes that the total stress remains constant during a transient process (Fredlund, 2001).

$$\frac{d}{dz}\left(k\frac{dh}{dz}\right) = m\gamma\frac{dh}{dt} \qquad (16)$$

Where:
k=Coefficient of permeability of the soil in the z direction
m=The slope of the soil water characteristic curve (water storage)
γ=Unit weight of water

The one dimensional form of the above equation is used in our matlab code to model Qattara Depression; the justification being that the lateral extent of the seepage flow is much larger than its depth, leading to vertical gradients being much larger than lateral ones. The value of the coefficient of permeability or also called hydraulic conductivity for this region is obtained from S. Rizk (Rizk, 1991) as 0.00025 m/sec as an average value for the Qattara Depression. The hydraulic conductivity varies from one region to another in the depression for that a sensitivity analysis was performed to determine the effect of the hydraulic conductivity changes on the model and the plant life. The tables below show values for the hydraulic conductivity and storage coefficient for many locations including Kharga,Dakhla, and Moghera which are close to the Qattara Depression. Definitely a site survey preformed on the exact nature of soil in the Qattara Depression would present more accurate results. But, using this study the model is run using different specific yields and for sand classified as fine or coarse and the results are compared. The value of the storage coefficient will be taken as an average of $2.84*10^{-4}$ and a sensitivity analysis performed. Equation (16) is going to be solved in the model by employing the finite volume method.

Initial conditions:

At t=0 $\left(\frac{dz}{dz}\right)_t = 0$

Boundary conditions:

h=ρgH

$\frac{dh}{dz}$=0

$$\int_t^{t+\Delta t}\int_z^{z+\Delta z}\frac{d}{dz}\left(k*\frac{dh}{dz}\right)dz.dt = m\gamma\int_z^{z+\Delta z}\int_t^{t+\Delta t}\frac{dt}{dt}dt.dz$$

Taking x=$\frac{k}{m\gamma}$ integrating the DE over a finite volume extending between z and z+ Δz, and time t to t+Δ t yields:

$$xh_{j+1}^{t} + (1-2x)h_j^t + xh_{j-1}^t = (1+2x)h_j^{t+\Delta t} - xh_{j+1}^{t+\Delta t} - xh_{j+1}^{t+\Delta t} - xh_{j-1}^{t+\Delta t} \qquad (17)$$

Equation (17) expressed at all nodes across the domain constitute a set of linear algebraic equations displaying a tri-diagonal matrix of coefficients. The time steps are taken as daily steps, and the space steps are taken as 1 m. An assumption is made that there are no rocks underneath the surface and that the seepage will continue. So for each time step the head is calculated for all the nodes. The head is then used to obtain the velocity at each node as it is the difference between the head between two nodes multiplied by the hydraulic conductivity. The velocity at the first node is then multiplied by the instantaneous area being solved for and that presents the outward seepage m^3/month.

Display of Results

The results that would offer a contribution to the planning of the project. As will be shown in the figures below the inclusion of the Chanel Flow in all the models and results did not have any effect on the life cycle or power production of the Plant. And that was the case no matter the breadth of the Chanel taken. The figures below show the effect of salinity on the surface level of the water in the Qattara Depression. We have three alternatives to compare between when assessing the effect of salinity on the plant life. First, we have salinity affect not included, second we have Ezz El Din's calculation explained above, and third there is the new detailed salinity calculation included in our Model. As seen from the results having no salinity the level of the lake levels out by incorporating Ezz El Din's method for salinity calculation the evaporation rate progressively decreases with the passage of time leading to the level of the lake to keep increasing. The new detailed method for Salinity showed the same affect but the results were less aggressive leading to a longer life. In the salinity comparison between all three different options for a fair comparison the same conditions were used in the model, same hydraulic conductivity and seepage and water inflow from the sea.

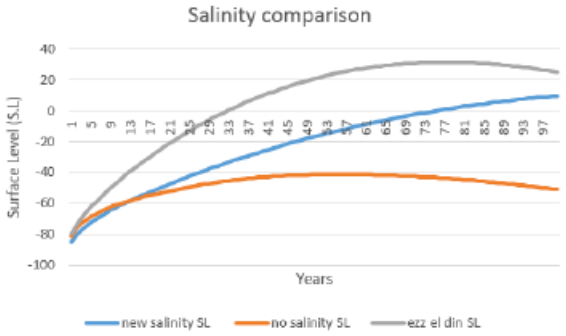

Figure 2: Salinity Comparison

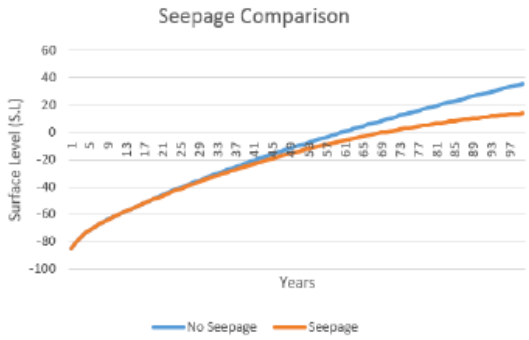

Figure 3: Seepage Comparison

Also, the effect of seepage was studied to show the effect of having this factor in the model. And it showed that after 100 years the level of the lake would be 14 m when seepage is included and 36 m when seepage is not included and in both cases salinity is calculated with the most updated method explained in this paper. The results show that the effect of increasing the hydraulic conductivity from 0.00025 m/sec to 0.0025 m/sec has a great effect on the overall results. Surface level (S.L) decreases to a lower level when hydraulic conductivity increases. And the surface level increases faster when hydraulic conductivity of the soil decreases.

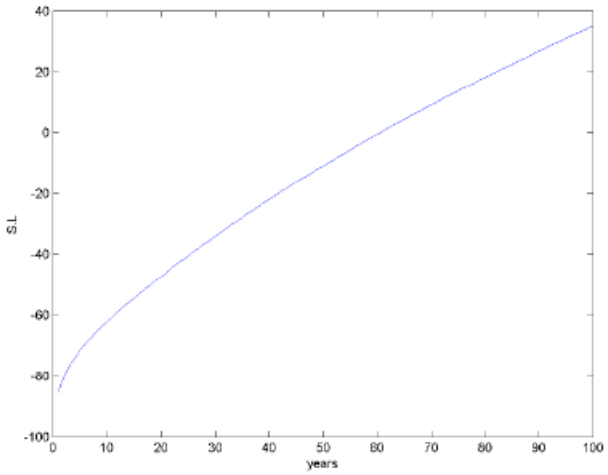

Figure 4: Effect of keeping the hydraulic conductivity at 0.00025 m/sec

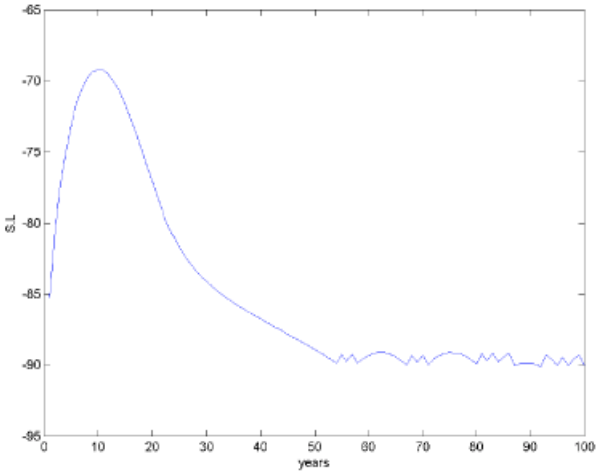

Figure 5: Effect of increasing the hydraulic conductivity

Summary and Conclusion

Therefore, as seen from the results Channel Flow has no effect on the plant life. But the effect of the new salinity calculation showed different results as the lake reached 10 m above sea level in the new salinity calculation while it reached 25 m above sea level using Ezz El Din's method after 100 years. And in both cases a 656 m^3/s flow was used and outwards seepage was incorporated in the models.

While outward seepage also showed a considerable effect on the results as the lake would last longer with outwards seepage calculated in the model. The manner of operation is flexible so it must not necessarily be 656 m^3/s. Different flow rates can be used and the plant does not have to be operational 24 hours/day it can be pumped hydro storage operation. All these new results would have great effects on the economic study preformed on such a project and the method of operation chosen which should be pumped hydro storage to prolong the plant's life time.

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Assessment of Disaster Safety at Matara District General Hospital in Sri Lanka

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Abstract
Hospitals are essential infrastructures in responding to disasters. They are expected to remain functioning during and in the immediate aftermath of disasters. Sri Lanka has experienced a number of natural disasters such as tsunami of 2004, and experienced inadequate disaster preparedness at many local hospitals. However, very limited research has been conducted in Sri Lanka about safe hospital issues. This study attempts to fill this gap by examining disaster preparedness at Matara District General Hospital. When tsunami affected Sri Lanka, this hospital area was devastated, and it remains to be vulnerable to natural disasters.This paper examines how doctors and nurses perceived the preparedness of this hospital by analyzing the results of the questionnaire survey. The results illustrated challenging areas in responding to a large number of disaster victims. Most of the respondents were unaware of the disaster response plan at the hospital. Also, they had not participated in disaster drills. However, almost all the doctors and nurses demonstrated their willingness to improve their knowledge on disaster management and to serve in future disaster situations.

Keywords: Disaster, health facilities, Matara District, preparedness, safe hospital, Sri Lanka.

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1. Introduction

Disasters, both natural and manmade, are increasing globally (WHO, 2015). Health facilities, especially hospitals, are essential in responding to disaster situations, including emergency treatment and trauma care. Health facilities are expected to remain accessible and functioning at their maximum capacity during and after disasters, emergencies, or other crises (UNISDR, 2009).

Studies have shown that disasters cause proportionally more damage to developing countries and poor communities (WHO, 2015). Natural disasters are more likely to affect people in Asia and the Pacific regions (UNESCAP, 2017). One climate change vulnerability index indicates that all seven cities globally classified as "extreme risk" are in Asia (Reliefweb, 2012). Since the early 1990s, natural disasters have cost Asia nearly $1 trillion, almost half of the estimated global cost for natural disaster damages (ADB, 2013).

A study that projects future impacts of disasters for the period between 2020 and 2030 suggests that people in most Asia-Pacific countries will be at high risk for injuries and fatalities. The Asia-Pacific region will endure 40% of the total future economic losses from disasters. Countries with special needs, particularly, in small island developing states like Sri Lanka, may lose almost 4% of GDP due to disasters (UNESCAP, 2017).

The international community has placed disaster risk reduction at the center of sustainable development (UNESCAP, 2017). The Hyogo framework for action (HFA) 2005-2015 and its successor, the Sendai framework for action (SFA) 2015-2030, highlight the importance of ensuring the resilience of critical infrastructure such as hospitals by undertaking disaster risk reduction actions. The SFA has a direct link to health. It promotes the safety of health facilities (IFRC, 2015).

The World Health Organization (WHO) has published a number of safe hospital reports and toolkits. It defines safe hospitals as "health facilities whose services remain accessible and functioning at maximum capacity and within the same infrastructure during and immediately following disasters, emergencies or crises" (WHO, 2008). The WHO "Safe Hospital Initiative" (SHI) concept meant to be adopted by hospitals globally to ensure the structural integrity and functionality of health facilities under disaster situations (WHO, 2015). In addition, it argues that making healthcare facilities safe and resilient is a very cost effective investment compared to spending on reconstruction after a disaster event (WHO, 2008).

The Sri Lankan government basically follows these international guidelines and frameworks, but some gaps still exist in structural, non-structural and functional aspects of hospital disaster preparedness in vulnerable areas like Matara district, our study area. Our research has revealed that virtually no study has examined the perceptions among doctors and nurses regarding the disaster preparedness of hospitals in Sri Lanka. Hospital administrations generally give less priority to disaster safety due to budget constraints. Lack of strong policies, legislation, expertise and technical know-hows are some other

drawbacks to improve disaster safety of hospitals in Sri Lanka. Thus, this paper examines how doctors and nurses in vulnerable coastal areas of Sri Lanka perceive disaster preparedness. In the following discussion, we first introduce our study area and its significance in examining disaster preparedness. Then our questionnaire survey methodology and results are discussed. Finally, we analyze the implications of our survey results for Sri Lanka and other small island nations.

1.1 Matara District General Hospital

Matara district is located in southern Sri Lanka on the land area of 1,282 km² and home to 831,000 people in 2014 (DoCSSL, 2017). Matara District General Hospital (highlighted orange in the map) is the largest public hospital in the district and also one of the main referral centers in the southern province of Sri Lanka. This hospital has 1,050 beds and employs 33 medical specialists, 290 medical officers, 902 nursing staff and 543 supporting staff. It serves the public 24/7. The hospital is located within fifty meters from the Nilwala, the largest river in the district. This rivershed is prone to flooding during the southwest monsoon and cyclones. The Indian Ocean is just 500 meters away from the hospital premises. Therefore, the vulnerability of the hospital to flooding and tsunamis cannot be ignored. As such, it needs to be well prepared to withstand and continue functioning during future disasters.

Figure 1: Map of the study area

This hospital has one doctor who was trained for disaster management. He made the disaster plan mostly to manage mass casualties arriving in the hospital due to external disasters. Only one disaster drill has so far been conducted in the hospital, which was in 2014. No national or internal plan exists to deal with natural disasters that affect this hospital itself (e.g., power failure, telecommunication failure, loss of ground transportation or evacuation plan during floods).

2 Methodology

The data collection was based on a questionnaire survey, field visit, phone interviews, and personal work experience in this hospital. The questionnaire survey was conducted from 10 to 30 September 2017. It aimed to assess the perceptions among doctors and nurses about the current level of disaster preparedness at Matara District General Hospital. The questionnaire consisted of thirty-four questions. The first set of questions aimed to identify the demographic characteristics of the respondents. Other questions attempted to understand various aspects of preparedness, including vulnerability, disaster response and capacity, communication facilities, critical supplies, transport availability, morgue capacity, willingness of the respondents, and future needs. In creating these criteria, we used some ideas from the WHO toolkit for safe hospital, especially its functional aspects (WHO, 2010).

A convenience sample of 30 doctors and 30 nurses was selected from the different units of the hospital. Sixty hard copies of the questionnaire were distributed and 10 were emailed to the respondents. Fifty-five hard copies and five emails returned with effective answers. The response rate for hard copies was 92% and that for emails 50%. The average response rate was 86%.

The field visit to this hospital was done in August 2016. Phone interviews were conducted in October 2017 with several chief nurses and administrators. In addition, Nimali Munashinghe, the lead author of this paper, has four-year working experience at this hospital as a doctor in the medical intensive care unit. This experience has helped better understand and analyze the results of this survey.

3 Results and Discussion

3.1 Demographic Characteristics of the Respondents

Figure 2-6 shows the demographic characteristics of the respondents. About 47% of them were aged between 30 and 39 years and about 68% of them were females. Significantly, male to female ratio among nurses was high (1:5). However, this ratio among the doctors was approximately one-to-one (1:1). In general, male nurses are few in number compared to female nurses in the hospital. The lower number of males in the nursing profession could be similarly seen in other hospitals in Sri Lanka, and it is due to the prevalent concept of nursing as mainly a care-giving female profession.

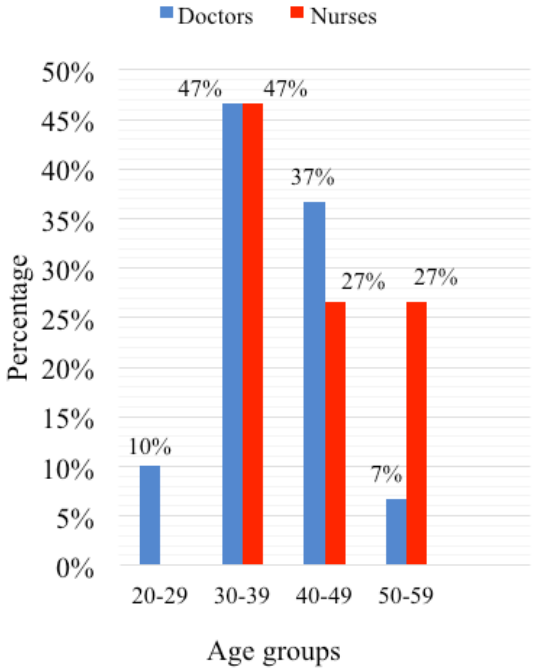


Figure 2: Age distribution

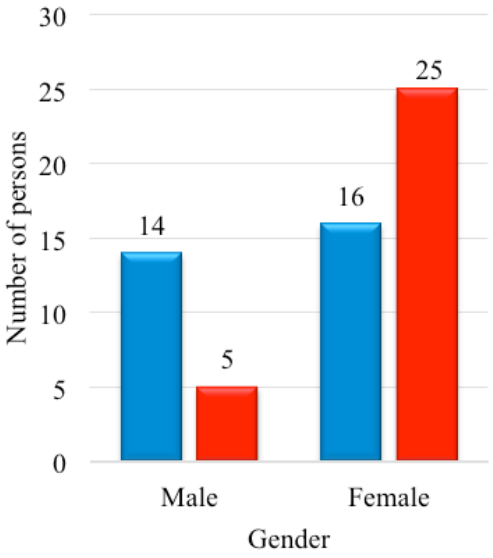
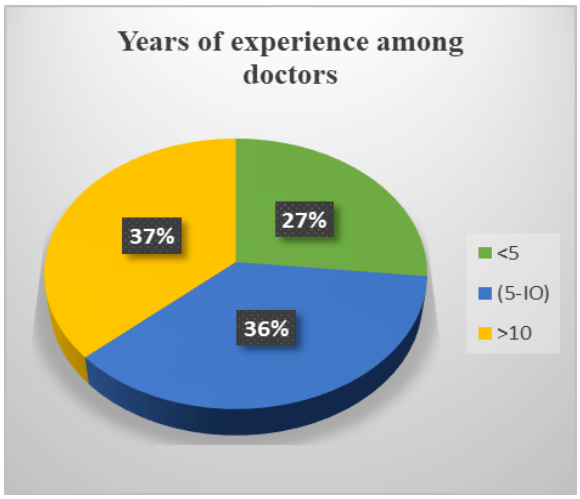


Figure 3: Gender distribution



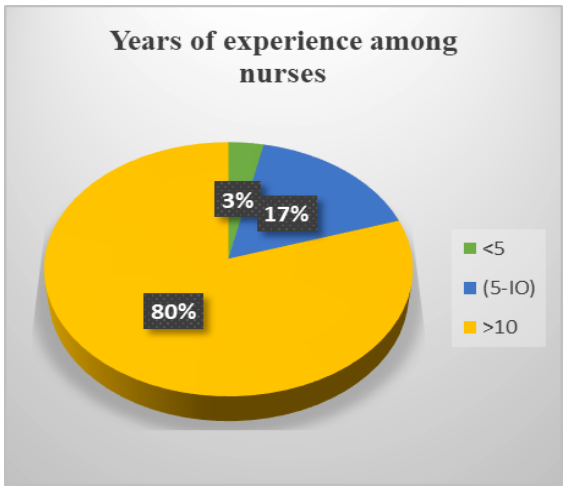


Figure 4: Years of experience among doctors Figure 5: Years of experience among nurses

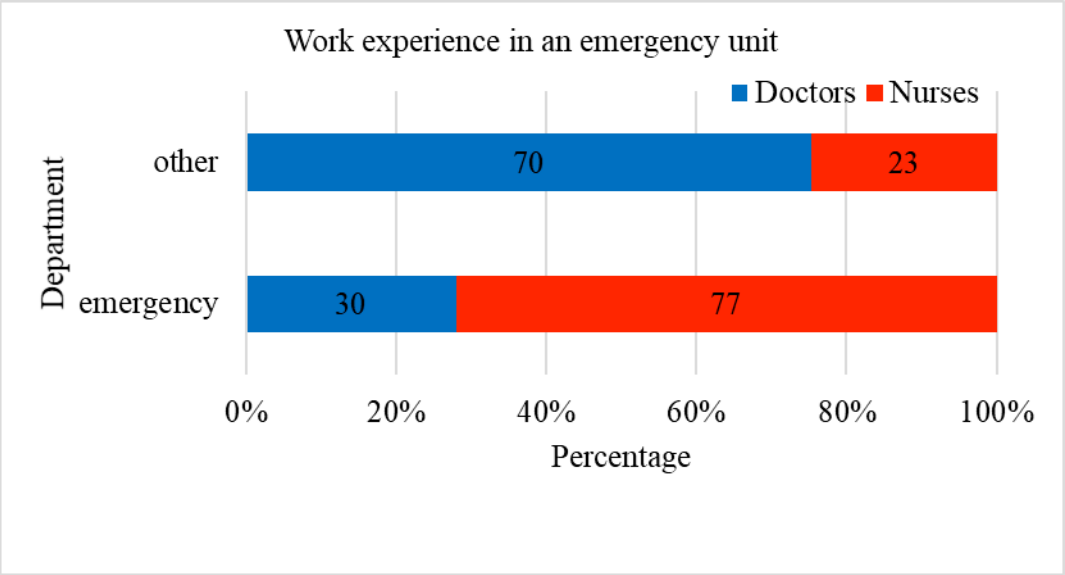


Figure 6: Work experience in an emergency unit

There were two administrative grade officers among the respondents, one consultant doctor and one chief nurse. The nurses had more work experience than the doctors in this sample. About 80% of the nurses had more than 10 years of work experience. Also, the majority of the respondents, mostly nurses, had worked in an emergency department. Nurses get their first appointment usually when they are about 23 years old whereas doctors do at about the age of 28. This means a five-year gap in work experience between the doctors and nurses. In Sri Lanka, doctors have to change the work place once every four years, but nurses are not required to do so. Therefore, nurses tend to be in the same duty station for a longer period of time.

From the total study sample, 57% had worked during a disaster situation. An equal number of doctors and nurses (17 persons each) had experienced some natural disaster in the area. Among them almost all had experienced floods or the tsunami of 2004.

Almost all the respondents agreed that the hospital is vulnerable to natural disasters. We provided six possible hazard categories to the respondents and asked them to rate each one's risk level in a five scale. Figure 7 below shows the result.

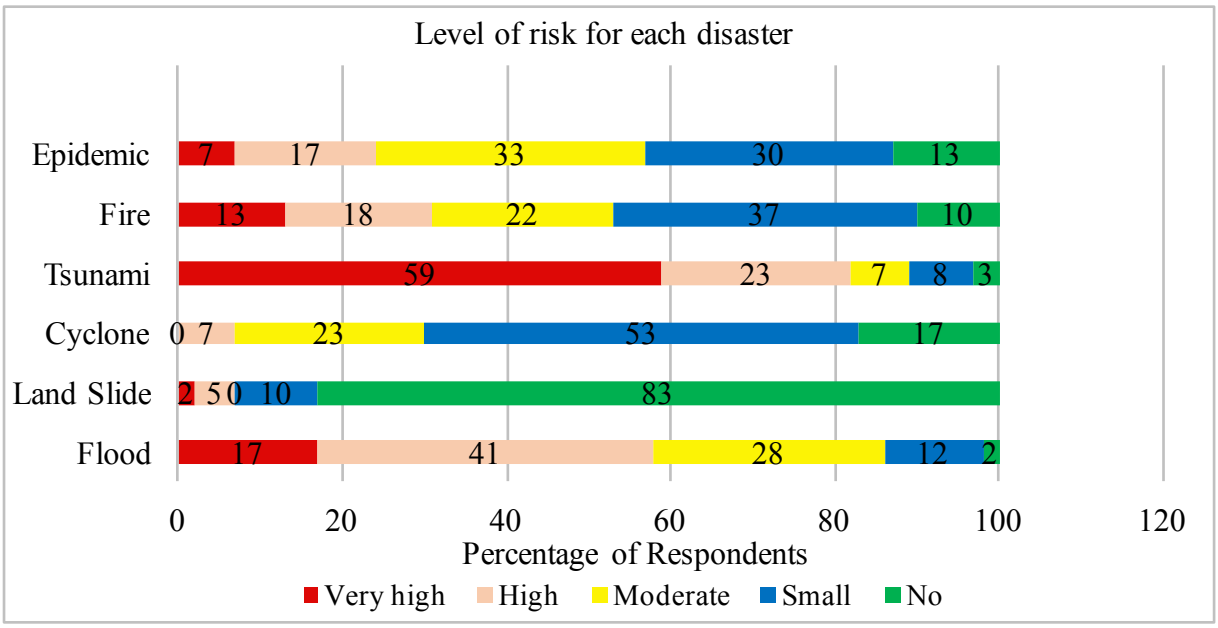


Figure 7: Level of risk for each disaster

We found that the doctors and nurses rated the tsunami as very high. Flood risk was rated mainly as high. Epidemic risk was moderate. Both cyclone and fire risks were rated as small risk. Landslides posed the least risk for them. The proximity of the hospital to the river (50m from the rear boarder of the hospital) and the sea (500m) at least partially explains this result. As the hospital is located in a flat land, the risk of landslide is almost nonexistent. Although there had not been any infectious disease outbreaks originating in the hospital, some external disease outbreaks were reported in the past. For example, in 2017 there was a deadly dengue epidemic throughout the country and this hospital was also overloaded with patients (Matara Interview, 2017).

3.2 Disaster Response and Capacity

Table 1 shows the respondents' perceptions about the disaster response and capacity at Matara Hospital. About 77% of them believed that the hospital would be accessible to the community if a disaster affected the area. This would be true if the hospital itself is not a victim of it. It is connected to four wide paved roads with several entrances and exits. Most doctors (70%) were aware of the disaster response plan, but 57% of nurses did not know about the plan. Also the majority of the respondents (70%) had not participated in disaster drills before. About 92% of the respondents were not familiar with their responsibilities in a disaster drill.

Table 1: Disaster response and capacity

Questions	Number of Doctors	Number of Nurses	Total
Accessibility of the hospital to the community			
Agree	23 (77%)	23 (77%)	46 (77%)
Not agree	7 (23%)	7 (23%)	14 (23%)
Awareness about the disaster response plan			
Yes	21 (70%)	13 (43%)	34 (57%)
No	9 (30%)	17 (57%)	26 (43%)
Participation for drills			
Yes	5 (17%)	13 (47%)	18 (30%)
No	25 (83%)	17 (57%)	42 (70%)
Familiarity with the responsibilities			
familiar	1 (3%)	4 (13%)	5 (8%)
Not familiar	29 (97%)	26 (87%)	55 (92%)
Awareness of evacuation area			
Yes	5 (17%)	13 (43%)	18 (30%)
No	25 (83%)	17 (57%)	42 (70%)
Number of casualties hospital could manage			
<=50	4 (13%)	5 (17%)	9 (15%)
50-100	11 (37%)	10 (33%)	21 (35%)
100-150	4 (13%)	12 (40%)	16 (27%)
>=150	11 (37%)	3 (10%)	14 (23%)
Adequacy of PPE			
Yes	6 (20%)	13 (43%)	19 (32%)
No	24 (80%)	17 (57%)	41(68%)
Adequacy of fire extinguishers			
Yes	3 (10%)	10 (33%)	13 (22%)
No	27 (90%)	20 (67%)	47 (78%)

Frequent drills and simulation exercises help people become more confident about and prepared for evacuation and their responsibilities. At Matara Hospital, however, only one disaster drill was conducted in 2014 (Matara Interview, 2017). We also found that 70% of the respondents were not aware of the designated evacuation area of the hospital. The available disaster plan did not address the evacuation from this hospital.

We then asked if the doctors and nurses have reasonably accurate ideas about hospital's capacity to treat disaster victims. We wanted to understand if they know how many victims the hospital can handle. Significantly, both the doctors and nurses in our survey had no clear idea about the number of patients they could effectively manage during a

mass casualty incident. The WHO suggests that prior preparation could prevent overloading the hospital. In case the hospital capacity is exceeded patients could be directed to neighboring hospitals (WHO, 2007).

In preparing for managing disaster situations at hospitals, doctors and nurses are expected to know if they have access to personnel protective equipment (PPE). We asked if the respondents think that Matara Hospital has adequate PPE for them. The result shows that 80% of the doctors disagreed. Also the majority (57%) of the nurses did not think PPE was adequate. Munasinghe's actual observation confirms this observation by the majority of the nurses. This result raises some concerns because, during epidemics or mass casualty incidents, the inadequacy of PPE leads to a further crisis, spreading infection among the staff and patients.

In connection to physical preparedness, we asked if Matara Hospital has properly installed fire extinguishers. Most respondents believed that available fire extinguishers were inadequate. During the field visit, I found only three fire extinguishers, and, the majority of the staff did not know how to use them. All the findings in this table highlight the inadequacy of their preparedness in emergencies and disasters.

3.3 Communication availability during disasters

Table 2: Availability of alternative communication facilities in the hospital

Alternative communication in case of blackout	Number of Doctors (%)	Number of Nurses (%)	Total (%)
Mobile	30 (100%)	30 (100%)	60 (100%)
Email	12 (40%)	5 (17 %)	17 (28 %)
Fax	3 (10%)	2 (7 %)	5 (8 %)
Walkie-Talkie	0	0	0
Ham Radio	0	0	0

When hospitals handle disaster situations and require additional help, it is important to secure communication. Often mobile phones become out of service during heavy disaster situations. So, we asked if doctors and nurses have knowledge about alternative communication methods. Table 2 shows the results. All the doctors and nurses said that they would relied solely on mobile phones in case landlines fail. Other than mobile phones, 28% said they would rely on emails. Only 8% of them would be able to use fax during a disaster situation at their hospital. No one mentioned about walkie-talkie, ham radio or any other communication facilities.

During a large-scale disaster situation land phones and mobile phones are rendered unusable due to power failures and damage to telecommunication infrastructure as Sri Lanka experienced soon after the tsunami of 2004 hit its coast. The situation would be the same with email communication. Walkie-talkie, ham radio or satellite communication facilities are very effective communication means during a disaster situation. However, none of these were available in this hospital.

3.4 Availability of critical supplies during a disaster

Table 3: Availability of critical supplies during a disaster

22.Critical resources availability	Number of Doctors (%)	Number of Nurses (%)	Total (%)
Running water			
1 day	8 (27%)	6 (20%)	14 (23%)
2 days	13 (43%)	3 (10%)	16 (27%)
3 days	4 (13%)	5 (17%)	9 (15%)
1 week	5 (17%)	16 (53%)	21 (35%)
Food			
1 day	14 (47%)	8 (27%)	22 (37%)
2 days	5 (17%)	3 (10%)	8 (13%)
3 days	6 (20%)	10 (33%)	16 (27%)
1 week	5 (17%)	9 (30%)	14 (23%)
Fuel reserves for generators			
1 day	5 (17%)	6 (20%)	11 (18%)
2 days	14 (47%)	9 (30%)	23 (38%)
3 days	6 (20%)	9 (30%)	15 (25%)
1 week	5 (17%)	6 (20%)	11 (18%)
Medicine, medical gases and blood products			
1 day	3 (10%)	0	3 (5%)
2 days	2 (7%)	1 (3%)	3 (5%)
3 days	10 (33%)	11 (37%)	21 (35%)
1 week	15 (50%)	18 (60%)	33 (55%)

Water, food and fuel reserves for backup generators, medicines, medical gases and blood products are the most essential supplies to continue the functionality of a hospital. Therefore, it is important for all staff to know how long these supplies last if additional supplies were not delivered. A water storage tank at this hospital is adequate only for one day if the municipal water supply is interrupted. The food supply is also on a daily basis, and no food storage facilities are available. The diesel fuel reserves for backup generators are adequate only for one day to keep the critical areas of the hospital functioning during a power failure. The storage of medicines, medical gases and blood products, however, are adequate for one week.

Table 3 above shows the perception of the doctors and nurses about these supplies. It revealed that both groups had poor understanding of the actual capacity of these supplies. The perception of the doctors was close to reality, whereas the nurses tended to exaggerate the availability of supplies. However, both groups had a reasonable understanding about the availability of medicines, medical gases and blood products as they are more familiar with these supplies during patient management. During disaster

situations, resources would be limited; so, effective and careful use of these scarce resources are very important.

3.5 Transport availability

Table 4 shows the transport availability of the hospital. The majority of the doctors and nurses (80%) did not agree it was adequate to bring in victims to the hospital in case of natural disasters. The hospital has eight ambulances with 1,050 beds. If patients in the hospital need to be evacuated, the available number of ambulances would be inadequate. Also, lack of a helipad is a major disadvantage if the ground transportation becomes impossible during floods. Also, Matara Hospital does not have prior agreements with transportation companies or private ambulance or boat suppliers (Matara Interview, 2017).

Table 4: Transport availability

Adequacy of ambulances with trained staff	Number of Doctors (%)	Number of Nurses (%)	Total (%)
Agree	6 (20%)	6 (20%)	12 (20%)
Do not agree	24 (80%)	24 (80%)	48 (80%)

3.6 Morgue capacity

The figure 8 shows the perception of the respondents on Matara Hospital's morgue capacity. Considering past experience, 70% of the doctors and 57% of the nurses agreed that the morgue capacity of the hospital is inadequate. The hospital morgue has the capacity to handle up to twenty bodies. However, the hospital and the premises were overloaded with thousands of dead bodies during the tsunami disaster in 2004. Therefore, they believed that during a major disaster, which results in many fatalities, the current morgue capacity is inadequate.

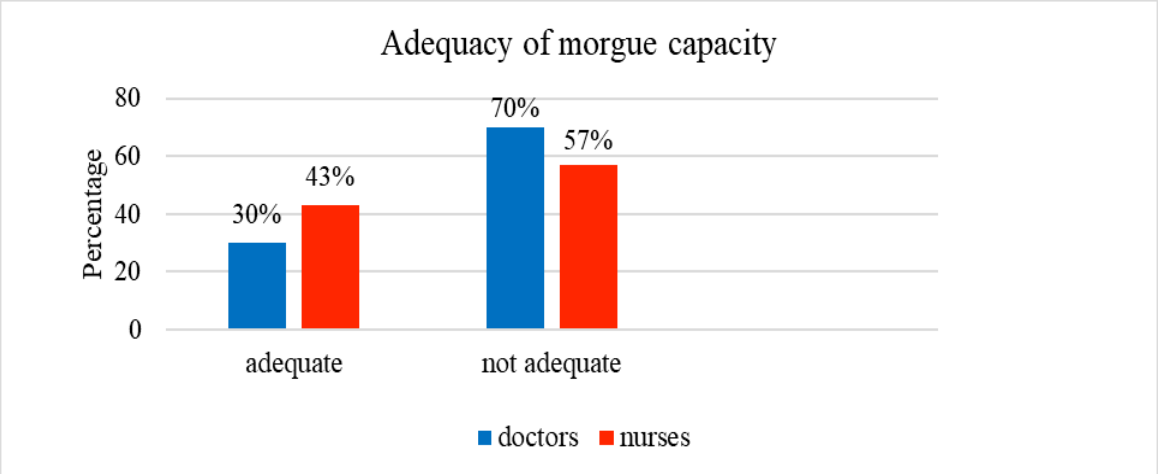


Figure 8: Morgue capacity

3.7 Willingness of the respondents

Table 5 shows the willingness of the respondents to improve their knowledge of disaster management. It also shows their willingness to work during future disasters. About 97% of the doctors and 80% of the nurses were willing to improve their knowledge of disaster management. Also, 90% of both groups were willing to serve during disaster situations. These results suggest that if the Sri Lankan government, Matara Hospital or other organizations can provide training, the respondents will improve their knowledge effectively and possibly become reliable disaster risk managers in the future.

Table 5: Willingness of the respondents

Willingness	Number of Doctors %	Number of Nurses %	Total %
Interested in improving knowledge			
Yes	29 (97%)	24 (80%)	53 (88%)
No	1 (3%)	6 (20%)	7 (12%)
Willing to serve during disasters			
Yes	27 (90%)	27 (90%)	54 (90%)
No	3 (10%)	3 (10%)	6 (10%)

3.8 Future needs

Table 6 shows the respondent's perceptions about the future improvements on hospital disaster plan. The majority of the respondents (65%) were of opinion that they needed a more comprehensive disaster management plan for the hospital. Also, most of the respondents believed that a disaster plan needs to be updated every six months or annually.

Table 6: Future needs

Future needs	Number of Doctors (%)	Number of Nurses (%)	Total (%)
Need more comprehensive disaster plan			
Agree	21 (70%)	18 (60%)	39 (65%)
Do not agree	9 (30%)	12 (40%)	21 (35%)
Frequency of update such a plan			
In 6 months	14 (47%)	22 (73%)	36 (60%)
Once a year	14 (47%)	6 (20%)	20 (33%)
In 2 years	2 (7%)	2 (7%)	4 (7%)

4 Conclusion

This survey revealed that Matara Hospital is more vulnerable to floods and tsunamis. The current disaster preparedness among its doctors and nurses is overall inadequate. The reasons were not attributed to gender, work experience and job types. This hospital's lack of preparedness was largely due to insufficient disaster drills and training. Nevertheless, both the doctors and nurses were willing to improve their knowledge about disaster management and willingness to serve in future calamities. Also, this study found that the available backup communication facilities, PPE (Personal Protective Equipment), fire protection, means of transport and morgue capacity of the hospital were inadequate.

Health authorities and the hospital administration should give priority to improve the identified gaps in the disaster preparedness to make the hospital more resilient in the future. A more comprehensive disaster plan should be prepared incorporating all possible hazards. This plan needs to be updated regularly. Also, our study revealed the existing high demands for capacity building and awareness-raising for the staff to deal with disaster situations in the future.

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Kenya-Tanzania Conservation Synergy for Migratory Lesser Flamingoes

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Abstract
Every year, about 850,000 flamingoes migrate between Kenya's Lake Nakuru and Lake Natron in Tanzania. In 2008, the Kenya National Single Species Action Plan for the Conservation of the Lesser Flamingo began to effectively conserve the lesser flamingoes in Kenya. However, good cooperation and institutional synergy between Kenya and Tanzania are essential for the success of this plan. Who would take up this task, however, is not yet clear. The Kenya Wildlife Service, which mainly undertakes wildlife conservation activities, is not prepared for establishing transboundary conservation actions for migratory birds. The East Africa Regional Lesser Flamingo Network has attempted to share action plans and information about conservation status with relevant countries. In order to foster this synergy, we argue, Kenya and Tanzania need to fully implement and comply with relevant environmental conventions and laws, strengthen and harmonize wetland and water bird legal frameworks, and promote research and data sharing about the lesser flamingoes.

Keywords: Lake Nakuru, Lake Natron, Lesser flamingo, Migratory birds, Transboundary synergy, Ramsar sites

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Introduction

This paper explores the challenges to establishing a Kenya-Tanzania transboundary conservation synergy for the migratory lesser flamingoes (*Phoenicoparrus minor*). These two countries play significant roles in protecting this species as they provide habitat to at least 77% of the world's lesser flamingoes. Recently the population has been declining (Table 1) partly due to habitat loss and lack of effective collaboration for its conservation (Nasirwa, 2000; Birdlife International, 2012a).

In Kenya and Tanzania, the protection of these birds and the habitat conservation differ considerably. In Kenya, the lesser flamingo habitats are protected areas, but in Tanzania they are either partially protected or not protected (Childress et al., 2007). This paper mainly focuses on Lake Nakuru in Kenya, an important single forage site for about 850,000 flamingoes (Nasirwa, 2000) and Lake Natron in Tanzania, the single most important regular breeding site for 1.5 to 2.5 million flamingoes (BirdLife International, 2016; Childress et al., 2007).

Flamingoes are the main tourist attractions at Lakes Nakuru and Natron. Lake Nakuru National Park is one of the most visited parks in Kenya with approximately 245,000 tourists annually (Nyunja, 2012). Through tourism, the lesser flamingoes contribute about US$26 million in Kenya and US$1 to 5 million in Tanzania (Wildlife Division, 2010). Therefore, a threat to lesser flamingoes and these two key habitats will possibly affect tourist revenues (BirdLife International, 2012a).

About the lesser flamingo

The lesser flamingo population was estimated to be in the range of 1,960,000 to 2,980,000 (Wetlands International, 2012), and they have been listed as a near threatened species on the IUCN Red List (BirdLife International, 2016). About one to two million lesser flamingoes breed in Lake Natron (Childress et al., 2007). The lesser flamingoes thrive in shallow and highly alkaline lakes mainly in the eastern Rift Valley, such as Lakes Bogoria, Elmenteita and Nakuru in Kenya and two others at Manyara and Natron in Tanzania (Childress et al., 2007; Nasirwa, 2000). They migrate as a group between these alkaline lakes. A tracking survey in Kenya indicated that in a span of fifteen months, the birds made up to 70 visits to as many as 11 lakes in Eastern Africa (Childress et al., 2007).

Table 1. Estimated global population of lesser flamingoes

Regions	Minimum	Maximum	Status
Eastern Africa	1,500,000	2,500,000	Declining
Southern Africa	55,000	65,000	Stable
South Asia	390,000	390,000	Unknown
West Africa	15,000	25,000	Stable
Total	1,960,00	2,980,000	

Source: Wetlands International, 2012

Every year, about 850,000 flamingoes migrate from Lake Nakuru to Lake Natron for breeding. According to the Kenya Wildlife Service experts, they migrate between August and September to Lake Natron. The peak period of breeding is during the months of October to November. They migrate back to Kenya around February to April. The migration period is largely determined by hatching period (Elowitt, 2015).

Lake characteristics

Lake Nakuru
Lake Nakuru is located inside Lake Nakuru National Park. This Park of 188 km^2 is situated at 0^0 24'S and 35^0 05'E in the Great Rift Valley of Kenya. The Park is situated roughly 3 kilometers south of Nakuru town (Gichuhi, 2008). It provides habitats to 450 bird species, 56 mammal species and 550 plant species (KWS, 2017; Nasirwa, 2000). The Park is surrounded by electric fences and regularly monitored by armed rangers mainly to protect wildlife.

Lake Nakuru has a surface area of about 45 km^2. The mean depth of this closed Lake is 2.5 meters (maximum 4.5 meters). It is also highly alkaline with a water pH of about 10 (Odada et al., 2006). Lake Nakuru is commonly known as "the Bird Watchers' Paradise" (KWS, 2017) as it is home to thousands of flamingoes (Gichuhi, 2008). The Lake was designated as the conservation area in 1957 and the bird sanctuary in 1960. A year later the Lake and its surrounding area were set aside as a national park (Odada et al., 2006; UNESCO, 2017). Its water sources include Baharini Springs and five seasonal rivers (the Njoro, Nderit, Makalia, Naishi and Larmudiak rivers) (Gichuhi, 2008).

Lake Natron
Lake Natron, a soda lake, is located at 02^0 21'S and 25^0 00'E in northern Tanzania near the Kenya-Tanzania border. Lake Natron is a closed basin with approximately 930 km^2 of the surface area. The Lake has a shallow basin with a maximum depth of 2 meters. It is highly alkaline with an average water pH of 12. The Southern Ewaso Ngiro River that rises from the Mau Forest catchment in Kenya primarily feeds the Lake. Other three small rivers, the Ngare Sero, Moinik and Pinyinyi, also run into the Lake (Ramsar, 2001).

Lake Natron is the single most important breeding ground for lesser flamingoes in the world. Approximately 1.5 to 2.5 million of them breed here. The Lake also has about 30% of the world's population of the threatened chestnut-banded plover (*Charadrius pallidus*) (BirdLife International, 2012a). Due to its importance it was listed as a Ramsar site and as an important bird and biodiversity area (Ramsar, 2001)

The pastoralist communities largely inhabit the Lake Natron Basin. About 95% of them belong to the Maasai tribe. Livestock, their main livelihoods, largely depends on the Lake Natron ecosystem. They also supplement their incomes through small farm irrigation and tourism (BirdLife International, 2012a).

Threats

Soda Ash Mining in Tanzania
One of the major threats to lesser flamingoes is a plan to mine soda ash in Lake Natron. In 2006, the Tanzanian government developed a plan to set up a soda ash factory at the Lake. The factory was expected to bring a net income of US$480 million. The National Development Corporation's research indicated that the mining of soda ash would not have any negative impacts on the breeding of lesser flamingoes (BirdLife International, 2012a).

However, many raised concerns about this plan. Some said that the disruption to the breeding site would occur as a result of water pollution and the usage of heavy machineries. It was estimated that 129,000 liters of fresh water per hour would be required to run the factory. This would threaten water security in this semi-arid region. Others feared that the factory would negatively affect local communities' livelihoods that directly depend on Lake Natron (BirdLife International, 2012a).

In 2007, the BirdLife International and Lake Natron Consultative Group launched the "Think Pink" campaign to save the lesser flamingoes. This Consultative Group is the coalition of 56 organizations. These organizations undertook intensive national, regional and international pressure campaigns and collected a large number of petitions against the plan. These activities successfully placed great pressure on the Company. On May 22, 2008, the Tata Chemicals Limited officially withdrew from the soda ash mining plan (BirdLife International, 2012a).

However, this was not the end of the story as the Tanzanian government could technically accept a new plan with new location and/or technology (BirdLife International, 2012a). In 2011, it announced its renewed interest in establishing a soda ash mining factory at Lake Natron.

This announcement puzzled many economists and policymakers as an earlier cost benefit analysis study indicated that a 50-year investment in soda ash mining at Lake Natron would lead to a loss of up to US$492 million. Alternative options were presented, including tourism and ecosystem conservation, which was estimated to yield benefits up to US$157 billion in 50 years (BirdLife International, 2012b).

Water level fluctuations in Lake Nakuru

Another threat lesser flamingoes face is drastic water level fluctuations in Lake Nakuru. In 2013, for example, the Lake water level rose rapidly and expanded lake's size from 27% to 40% of the National Park area. The water level rise reduced alkalinity, forcing flamingoes to move to neighboring Great Rift Valley lakes like Elmenteita and Bogoria in Kenya (Moturi, 2015).

Deforestation in the Mau Catchment

The deforestation and encroachment of the Mau Forest is another threat. These are partly blamed for the water fluctuation problem discussed above. The Mau Forest is the main catchment area for Lakes Nakuru and Natron. Four of the five seasonal rivers that feed Lake Nakuru, and the Southern Ewaso Ngiro River that drains into Lake Natron, arise from the Mau Forest. Some studies estimated that 41% of the Forest was lost between 1973 and 2009 (Khamala, 2010; Olang and Kundu, 2011). Since 2009, the Kenyan government has attempted to enhance catchment conservation (KTWA, 2017).

Impact of intensive agriculture

Both lakes also have experienced agricultural pollution. Most farmers in Njoro and Elburgon regions in Kenya (eastern part of the Mau Forest) have used synthetic agrochemicals extensively and polluted rivers that flow into Lake Nakuru (Gichuhi, 2008). The damming of the Southern Ewaso Ngiro River in Kenya for irrigation

purposes has obstructed the normal water flow. Extensive irrigation activities resulted into pollution with synthetic agrochemicals (Ramsar, 2001).

Factors impeding Kenya-Tanzania collaboration

Inadequate Compliance with International Agreements

Kenya and Tanzania face these challenges on top of their obligations to meet international treaty requirements. Lake Nakuru (Ramsar, 2005) and Lake Natron (Ramsar, 2001) are designated Ramsar sites. After ratifying the Convention on Wetlands of International Importance especially as Waterfowl Habitat (mainly known as the Ramsar Convention), these countries promised to establish a number of proper wetland conservation measures, including the protection of migratory waterbirds (UNESCO, 1994). The Convention calls for a proper management in the "shared wetlands." Although it does not define the shared wetlands, with the proper emphasis on migratory waterbirds, one may argue that Lake Nakuru and Lake Natron are virtually shared through the frequent migration of the lesser flamingoes between these two lakes.

Kenya and Tanzania also have agreed to cooperate in protecting migratory species by ratifying other transboundary agreements. For example, the Convention on the Conservation of Migratory Species of Wild Animals (CMS) and the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) require respective parties to take coordinated efforts to protect migratory (waterbird) species (AEWA, 2015; CMS, 1979). So far, Kenya and Tanzania have not done so.

The reason can be at least partially attributed to Tanzania's policies. The Tanzanian government does not appear to be committed to implementing the Ramsar Convention requirements in managing Lake Natron. Going back to the soda ash mining case, for example, the Convention requires parties to notify the Secretariat about planned developments on Ramsar sites if they will or likely affect ecological characteristics (UNESCO, 1994). Tanzania did not inform the Secretariat about its plan to mine soda ash (BirdLife International, 2012a).

The Tanzania government might have found it unnecessary to inform the Secretariat because it believed that the mining would not affect Lake Natron's "ecological characteristics." However, it has also ratified Principle 15 of the Rio Declaration on Environment and Development (UNCED, 1992), Decision II/10 of the Convention on Biological Diversity (CBD, 1995) and the AEWA's second fundamental principle (AEWA, 2015). These principles and decision promote the precautionary principle.

Resolution VII.16 of the Ramsar Convention requires that a project that "potentially" alter the ecological character of a Ramsar site should be subjected to a rigorous impact assessment (Resolution VII.16). This Resolution is not alone. The Convention on Biological Diversity and the AEWA expect that all countries with a shared basin/wetland should be involved in the environmental impact assessment process (Resolution VII.16, UN, 1992; AEWA, 2015). In promoting the soda ash mining, Tanzania did conduct the environmental and social impact assessment, but it did not carefully consider impacts on lesser flamingo breeding. Only selective information was made available to the public and relevant stakeholders (BirdLife International, 2012a).

Kenya has also been partially blamed for threatening the lesser flamingo breeding site at Lake Natron (Clamsen et al., 2011; Ramsar, 2001). It constructed Oletukat Olenkuluo, Leshota and Oldorko dams on the Southern Ewaso Ngiro River for water supply, irrigation and hydroelectric generation (Alliance of Leading Environmental Researchers and Thinkers, 2017). This River is the primary water source for Lake Natron and plays an important role in maintaining the Lake ecosystems (Ramsar, 2001). The dams are reducing sediment/nutrient flows into the Lake and causing the decline of blue algae, which is the main plant the lesser flamingoes feed on (Alliance of Leading Environmental Researchers and Thinkers, 2017; Ramsar, 2001). The Kenyan government also did not engage Tanzania in the environmental impact assessments for the construction of these dams as required by the Convention on Biological Diversity (UN, 1992) and AEWA (AEWA, 2015).

East Africa Community Environmental Agreements

Regarding regional transboundary legal frameworks, negotiating over the proposed East Africa Federation, six countries in the East Africa Community (Burundi, Kenya, Rwanda, South Sudan, Tanzania, and Uganda) have shown interests in collaboratively managing the environment. As a result, the 2006 East Africa Protocol on Environment and Natural Resources Management was established. Nonetheless, Tanzania has not signed it (Wabunoha, 2008). This has impeded transboundary conservation initiatives to conserve lesser flamingoes. Also, the capacity of the East Africa Court of Justice is still limited in resolving environmental disputes. The implementation of the Protocol plays an important role in further empowering this Court.

Legal and regulatory frameworks for collaboration

Legislative frameworks are necessary for building foundation for joint policies and action plans. The two countries have established wildlife protection laws. Kenya has the Wildlife Management and Conservation Act (2013). Tanzania has the Wildlife Conservation Act (2009). The implementing agencies are the Kenya Wildlife Service and the Wildlife Division of Tanzania. These laws authorize these responsible agencies to conserve wildlife and combat wildlife crimes. They also provide avenues for regional cooperation in the management of transboundary wildlife conservation areas. Waterbird species are implicitly protected.

The National Wildlife Conservation and Management Policy of Kenya (2017) (MENR, 2017) and the Wildlife Policy of Tanzania (2007) (MNRT, 2007) also promote collaboration with relevant regional and international stakeholders in implementing these policies. So far, Kenya and Tanzania have established collaboration in the management of the Mara River Basin particularly to protect wildlife migration between Serengeti National Park (Tanzania) and Maasai Mara National Reserve (Kenya). Although this type of cooperation has not yet been done for the lesser flamingoes, the Mara River case demonstrates the possibility for doing so.

Kenya and Tanzania also have potential legal grounds to establish better collaboration and policy synergy. Article 109 of the Kenya Wildlife Management and Conservation Act (2013) and Article 94 of the Tanzanian Wildlife Conservation Act (2009) commonly stipulate that responsible ministers in both countries have power to

negotiate over regulations and conservation measures for transboundary habitats. These Articles also empower them to ensure compliance with ratified international agreements. These provisions pave way for joint ministerial committee/meeting on the conservation of migratory flamingoes and their shared habitats. The committee can recommend on how these countries can collaboratively manage wildlife.

The two countries have already collaborated on the management of the Mau Forest mainly under the Lake Victoria Basin Commission and the Mara River Transboundary Water Users Forum (WWF, 2010). A similar effort can be done for effectively managing the Southern Ewaso Ng'iro River, another transboundary water body. The water laws mandate the Water Resources Authority of Kenya (Water Act, 2016) and the Water Resources Division of Tanzania (Water Resources Management Act, 2009) to coordinate with regional stakeholders in using transboundary water resources. The collaboration can help determine the quantity of water stakeholders can use/share. The two authorities can help the Kenya Wildlife Service, Tanzania's Wildlife Division and other relevant stakeholders to monitor water quality standards in the Southern Ewaso Ng'iro River to reduce and/or prevent pollution in Lake Natron.

The two countries also need to establish dispute resolution mechanisms in case there is lack or mismanagement of shared resources and overlapping claims to water. One option is to empower the East Africa Legislative Assembly to develop binding regional/bilateral environmental laws. This will enable the East Africa Court of Justice to effectively address transboundary environmental disputes and crimes. In the absence of the legal ground, a joint ministerial committee can alternatively address some disputes. Community authorities can also resolve small conflicts. This is likely to be effective considering Maasai people are the main residents around Lake Natron in both Kenya and Tanzania. They can easily communicate in both Maasai and Swahili.

Research and Monitoring

Research is often seen as a major drive for collaborative environmental governance particularly for migratory waterfowls (Kirby et al., 2008). Understanding their migration route, breeding habitats and their interaction within an ecological context is essential for their conservation and effective collaboration. Research on migratory species helps to inform policies and aid the development of transboundary conservation plan and bilateral/multilateral agreements.

Lack of sufficient scientific information about lesser flamingoes and their habitats has hindered their conservation and Kenya-Tanzania collaboration. For instance, very limited studies have been published that inform environmental impact assessment on soda ash mining in Lake Natron (BirdLife International, 2012a). There is no established data sharing methods among the key conservation agencies, hence limiting the accessibility of data (Iliffe et al., 2011).

Research institutions for wetlands and water birds play important roles in facilitating collaborative research between Kenya and Tanzania. The Kenya Wildlife Service and the Wildlife Division of Tanzania are the closest agencies responsible for management and conservation of the wetlands. The Service manages Lake Nakuru and Division manages Lake Natron. The Division has an independent research body,

the Tanzania Wildlife Research Institute (TAWIRI), for conducting and coordinating wildlife research. It has not yet focused on waterbirds, however (TAWIRI, 2018). The Kenya Wildlife Service has no independent research institute to conduct research not only on the wetlands but also on wildlife conservation. The Wildlife Conservation and Management Act (2013), however, mandated the establishment of the Wildlife Research and Training Institute.

Financial constraints and insufficient institutional capacity are serious challenges to the Kenya Wildlife Service and the Wildlife Division of Tanzania. Monitoring migratory birds is an expensive task. So far, the Nakuru branch of the Kenya Wildlife Service has no wetland division or staff. The Service's headquarter in Nairobi, which is the Kenya's focal point for the Ramsar Convention, has a wetland department with less than ten employees.

In 1991, Kenya started taking the African Waterbird Census in collaboration with Wetlands International. The lesser flamingoes censuses are frequently conducted in Lakes Bogoria and Nakuru by reserve/park staff (Iliffe et al., 2011). The censuses are less frequently conducted in Tanzania (Clamsen et al., 2011; Iliffe et al., 2011). However, as there has not been an attempt to count the number by two countries, it is still challenging to estimate the actual population and changes of eastern African lesser flamingoes.

Collaboratively monitoring and sharing information are important to conserve flamingoes and other migratory bird species. The collaboration between the Kenya Wildlife Service and Tanzania's Wildlife Division is essential for this purpose. For example, if the Wildlife Research and Training Institute is established, it can propose a memorandum of understanding with TAWIRI to conduct joint research on migratory species. Research institutions also need to harmonize research permits for transboundary research. To encourage information sharing and dissemination, the two institutions can organize frequent conferences in partnership with local universities and relevant stakeholders.

Synergy in research can also be developed through inter-university collaboration, not only between the two countries but also with universities from other countries. This can help overcome financial burden at least partially. If possible and where necessary, migratory bird research can involve governmental and non-governmental conservation organizations, such as the African Conservation Center, African Wildlife Foundation, BirdLife International, Japan International Cooperation Agency, Kenya Wildlife Service, International Union for Conservation of Nature, Tanzania National Park Authority, Wetlands International, Wildlife Division of Tanzania, and World Wild Fund of Nature, among others.

Conclusion

This paper has argued that Kenya and Tanzania have much room to improve the conservation of the lesser flamingoes. The frequent migrations of the lesser flamingoes between Lakes Nakuru and Natron require wildlife protection officials to more actively engage in transboundary conservation activities. Kenya and Tanzania so far have not adequately ratified and observed international agreements that are relevant to the protection of the lesser flamingoes. One potential option to improve

transboundary synergy for wildlife conservation is to empower the East African Legislative Assembly to develop binding regional environmental laws. This Assembly may also enable the East Africa Court of Justice to better address transboundary environmental mismanagement and crimes.

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Culture and Identity in Public Green Spaces: Story of Suropati and Menteng Park in Central Jakarta, Indonesia

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Abstract
Changing the role of parks and green spaces to fit into the sustainable city framework are now an ongoing agenda for city planners worldwide. One popular concept is how green spaces promote urban *liveability* and *sociability* among city dwellers. While parks provide environmental benefits, parks are also public spaces that come with historical heritage, culture and social identity of the urban residents. This paper explores the subjectivity of urban life collected from the perspectives of different individuals on how they engage with the conception of living in a megacity and park use. Case study sample selected for this research takes place in Menteng sub-district where the first and oldest urban park located in the Special Capital District of Jakarta Central, Indonesia. The discussion that follows takes three central stories of different themes: 1.the city's relation to memory and perception, 2. Influence of urban life to changing tradition and culture 3. The role of the people in everyday makings of the city. The results presented demonstrate the different styles of meaningful interactions with others within the park, the different "spatial story" to tell within the larger social order of urban life in Jakarta.

Keywords: Urban parks, Culture of cities, Social Space, Jakarta, Livability

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Introduction

In the cities of major developing countries worldwide, there is an increasing interest in studies on the importance of green spaces for sustaining quality of life for cities and the challenges facing cities undergoing densification (Anguluri & Narayanan, 2017; Chiesura, 2004; Haaland & van den Bosch, 2015; Schetke, Qureshi, Lautenbach, & Kabisch, 2016). Negative impacts of urbanisation highlighted by Haaland (2015) included decrement of green spaces, economic disparities and social inequalities that rises with population influx and poor planning which show the highest percentage in Asian cities. Nevertheless, Chiesura (2004) draws the attention mainly back to the critical contribution of urban parks in playing a part in aiding not only for the social but also the economic value for the urban residents.

Undeniably, much of the focus of studies within the disciplines of the built environment still focuses on the environmental solution which green spaces provide. However, the importance of green open space no longer becomes just a matter infrastructure necessity, but also an indicator for environmental performance and a bridge for different disciplines to study together towards a better chance of a future (DE Aldous, 2010). This is especially true for coastal cities that are vulnerable to environmental threats from climate change as well as urban densification issues such as the case for Indonesia's capital city Jakarta.

Discussion put forward by Steinberg (2007) calls for attention on how the former colonial capital of Jakarta became from a "world city" to a "crisis city" with its struggles of modern day infrastructure as well a myriad of environmental challenges such as rising sea levels and annual flooding. Much of studies done on this controversial coastal city shows the source of the rapid development was from the concentration of foreign and domestic investments during the early 1990s (Firman, 1998). Coupled with the dualities between formal and informal settlements (Zhu & Simarmata, 2015), the attempt to hasten the modernisation quickly contributed to a different type of socio-economic problem that can only be compared to other major cities of Latin America and Africa during the 1980s.

Studies by environmental psychologists such as Kaplan(1995), Ulrich (1991) and Kjellgren (2010) have proven the mental benefits and the restorative value of green areas in cities and its residents. Their strategies adopted well into the open green space design criteria proposed by the World Health Organisation (WHO) in 2016 for improving health and well-being. While much of content of the guide is achievable goals for developed countries in the EU, the UK or America, a city with a rapid but short urban development history like Jakarta, requires a more specific understanding of the complex socio-spatial context relating to Indonesian context and local values, before commencing any further with spatial planning strategies.

Related works

Since first appeared in1950s, the term "*livability*" has been widely used in a variety of context for urban-related projects. According to a historical review by Kaal (Kaal, 2011), the definition of the term urban livability slowly morphed from country to country, discipline to discipline with one main aim to "*improve one's life quality*", and yet still covers a broad range of non-definitive or universally agreed definition to *"who's*" life quality is it really for.

From being the first key issue discussed in the Congress of European Society Rural Sociology in Belgium in 1959 to address agriculture issues and negative impact urbanization had on rural communities, to the 1960s concern of the impact of modernization on the urban spaces (such as Jane Jacobs's *Life and Death of American Cities* in America), Kaal concluded that the best way to improve the understanding of this term is to contextualize "*where, when, by whom and why, as well as for which reason(s) this concept is applied*" (Kaal, 2011)for changing governance of a place.

This paper aims to discuss the spatial stories existing in the current urban practice in context of 21st Century Jakarta, Indonesia. The study has taken into account the varied multi-cultural and socio-economic background of its residents, as well as the histories that accompanies the selected case study sites.

Study Area

The area of Menteng is a small suburb of Jakarta Central, a sub-district region in the special capital region of Jakarta, Indonesia. This area was the south part of the Dutch Colonial City of Batavi (as Jakarta was formerly known) founded in the 17th century. It was recognised nationwide for the development of Menteng Residential Village, the first planned urban residence in the early 1900s, as part of an expansion plan for the long-standing colonial city. After 1910, when the region was developed for town development, the area became known as Nieuw Gondangdia, a residential zone designed by Dutch Architects P.J.S. Moojen and F.J. Kubatz in 1913.

At that time, the Menteng Project was designed following a European hierarchical system that divided streets and houses into several classes, depending on their hierarchy in the colonial official ranking. The park changed its name to Suropati park after the Independence of Indonesia on August 17th in 1945(info.jakarta.net, 2015).

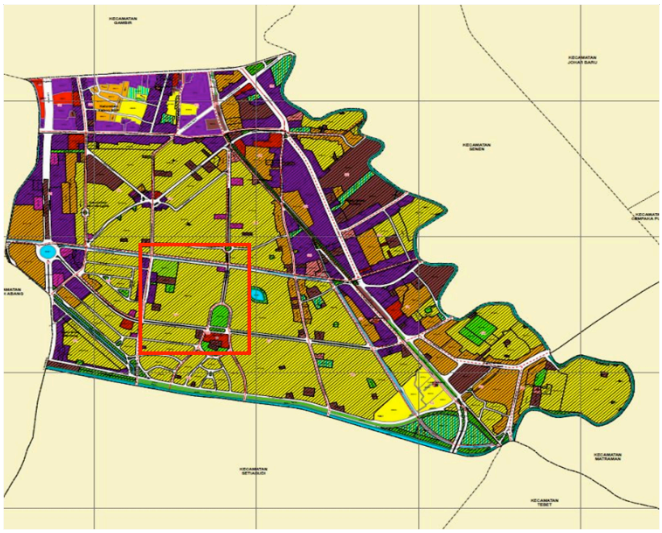

Figure 1 Map of the administrative village of Menteng with the location of case study parks (Taman Suropati and Taman Menteng) in highlighted within red boundaries. (Source: Spatial Planning Master Plan, 2016)

Former *Burgemeester Bisschopplein* or Taman Suropati is located across what is currently the administration office of the Vice President of Indonesia, sits as also opposite of the official residence of the Ambassador of the United States.

The second case study site of Menteng Park was previously a part of a sports stadium known as *Voetbalbond* Indische *Omstreken Sport* built in 1921 by two Dutch Architects that was also responsible for the developing the Menteng district during the development of the Batavia City (Idris & Yunanto, 2009). According to stadium training grounds for the Dutch colonial officers for their leisure and sporting activities.

After Indonesia's Independence, from 1961 onwards the stadium became training grounds and main headquarters for local football "Persija" Jakarta team (Dundu, 2005). The prestige and popularity of "Persija" team brought followers and fans from all over Indonesia to this stadium to watch a game or see the team train. This iconic stadium generated income not only for the nearby shop houses[i] and small business in the area but also became grounds for local community building for the youth in pursuing careers in sports and healthy life. The site converted into Taman Menteng in 2007 following a very public dispute that resulted in the demarcation of the Stadium in 2005. (Idris & Yunanto, 2009).

Methodology

For this paper, both quantitative and qualitative approach is adopted to triangulate experience of parks as well understanding underlying issues concerning the governance of green spaces in Jakarta, Indonesia. Figure 2 is a diagram showing a summary of the data collection and early data analysis carried out during the fieldwork. For the purposes of this paper, discussion will focus on the themes founded based on fieldwork data analysis.

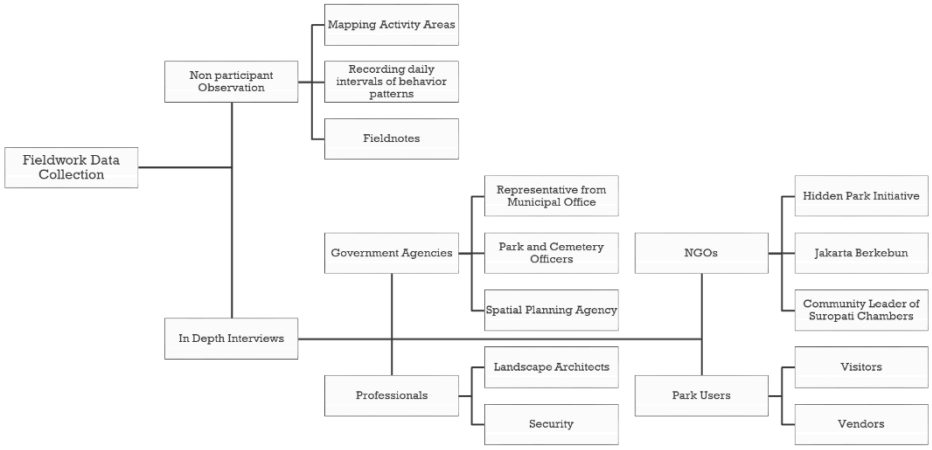

Figure 2 showing the fieldwork of data collection process in Jakarta, Indonesia between August 2015 to April 2016 (Source: Author)

Observations take place between 10 am to 9 pm divided into 2-3-time periods to allow enough rotations of areas onsite. Monitoring times were distributed across several weekdays, Saturdays or Sundays, capturing the range of activity types occurring at different peak and low times at both case study sites.

All in-depth interviews took place between August 2015 to April 2016 with the majority between March and April of 2016. Choice of venue was decided by interviewee for the convenience of time and transport. Majority of the interviews were conducted in a series of semi-structured interview and conducted in an informal, conversational matter. Each question asked are outlined with the established aims for the answering specific research theme. Some interviews were held over more than an hour long especially when the interviewees were telling their personal stories related to the social activities that occur in public parks. In some cases, the interviewees were found that the study was very interesting for them.

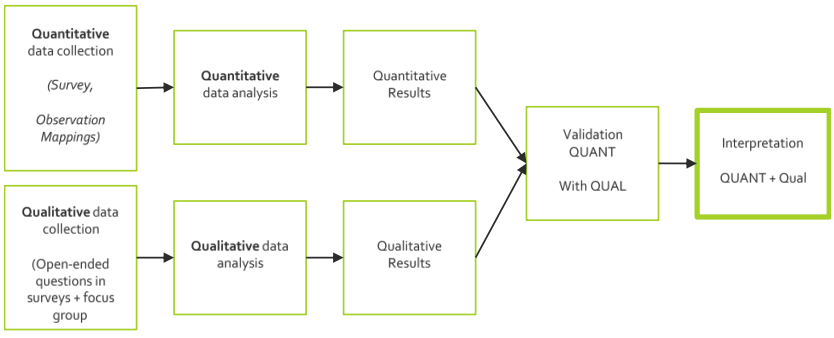

Figure 3 Triangulation of data adapted from Creswell (2013)

To present both the qualitative and quantitative findings from the data collection shown in earlier Figure 2, triangulation shown in Figure 3 is a process of listing components of the study that converge or offer complementary explanations between

the different methods of data gathering. This process of explicitly searching for obvious discrepancies or similarities [between data] is an integral step to make sense of an overall analysis of this study.

Findings

In total, 310 respondents took part in the questionnaire in both parks which resulted in 8 focus groups. This sample included 159 for Taman Menteng and 3 group interviews, 151 for Taman Menteng with 5 group interviews. Taman Menteng had the higher percentage of younger respondents, while Taman Suropati had the highest percentage of people over 35. While the questionnaire data shows the dominant respondents are found to be young adults between 18-to-25 age range (45%), this figure only reflects a sample of park users present during the fieldwork observation times.

Overall, results from the quantitative survey questionnaires demonstrates a broad range of visitors and regular park users of diverse cultural and ethnic background to both case study sites. Pie chart from Figure 5 appears positively supporting the ethnic and racial quota supplied by Jakarta Census Data. Figure shows good percentage from both the Javanese [the local] of 46 % and other smaller ethnicities from other parts of Indonesia Archipelago areas, making up between 0.8 to 21% of total respondents.

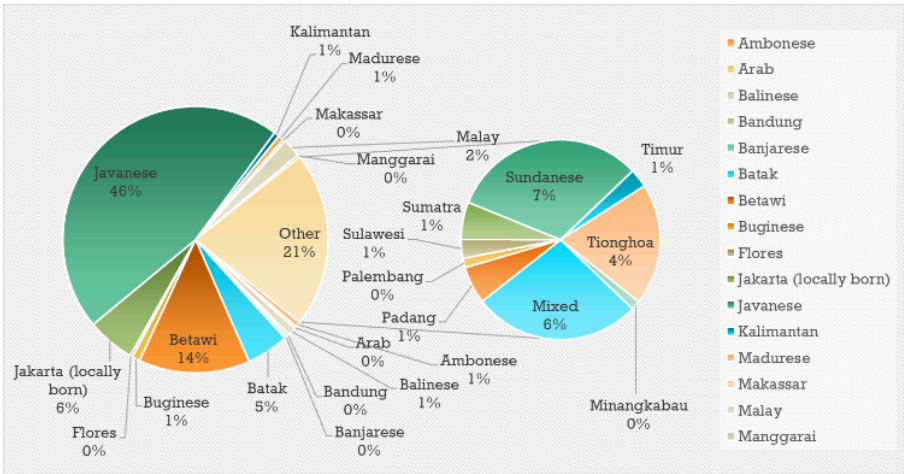

Figure 5 Ethnic background from 306 onsite survey participants of Suropati and Menteng Park between March- April 2016 (Source: Author)

In matters of territoriality of the public space, Ash Amin (2008) suggests how the "*sociology of public space* and *politics of space"* can almost be read in the same way *"…dynamics of mingling with strangers in urban public space are far from predictable when it comes to questions of collective inculcation, mediated as they are by sharp differences in social experience, expectations and conduct."* This is conclusive with analysis findings that suggests how some groups of park users may be self-segregating themselves through their choice of participation in the types of activities in the park.

This participation narratives (see Table 1) gives an overall idea of the pattern that emerges in the two case study sites from observation and results of the questionnaire surveys. Recurrent activities which happens at different times of day of the week, occupying different areas of the park indicates different types of values park users can identify themselves with. These references made in the surveys were then explored further during group interviews. The discussions about specific activities engaged in the park suggest that they are considered by interviewees as productive spaces which confer value onto place.

Table 1 Simplified taxonomy of participant observation and questionnaire results between the two case study sites. Further evidence of the activities is shown in the images in the continued sections of this paper. (Source: Author)

Activities observed/ mentioned in interviews	**Evidence/Presence of activity (Percentage)**					**Themes**
	Taman Menteng		**Taman Suropati**		**100 %**	
Arts, culture, heritage events	•	40%	•	60%		Identifies cultural activities on site
	•	50%	•	50%		Identifies diversity of people
Community Activities (regular meetings, gatherings)	•	50%	•	50%		Identifies community link on site on site
Political events	•	30%	•	70%		Identifies Social movements
Street vendors, flea markets	•	50%	•	50%	100 %	Identifies economic opportunities
Religion/Spirituality Events	•	100%		0%		Identifies religious significance
Relaxing (Sitting, lounging, eating, People-Watching)	•	40%	•	60%		Identifies leisure activity
Isolation	•	80%	•	20%		Identifies non-social activity
Sports, active recreation	•	75%	•	25%		Identifies health and social activities

Cultural Activities include traditional or local events involving indigenous tribes of Indonesia such as traditional concert, dance or art shows from specific regions of the Indonesian Archipelago. Taman Suropati is a prime location for such events more than Taman Menteng despite being the smaller, less equipped space for the occasion.

Diversity refers representations of the different demographic groups of respondents on site as well as from observation recorded. This applies to respondents age, ethnicity, religious affiliations and socio-economic backgrounds. In this account, both parks are equally representing Jakarta's multi-cultural dynamics.

Community link refers to the presence of groups that identifies with similar cause either ethnic group, hobbies or activity that is recurrent and ongoing. Although percentage shows an equal distribution, the type of community that exists each park are dependant and limited on the availability of space and existing facilities that came with each site.

Religious significance refers to occurrences related with any specific religious practice on the site itself such as prayers, ceremonial rituals and such. In this regard, Menteng park has an advantage of giving an entire space of the parking building to accommodate for Muslim prayers to its users. Park users in Taman Suropati, however, uses the nearby mosque for their call of prayers.

What does an urban park say about the identity of its residents

Many urban scholars throughout history agree that the urban public space has always been an integral part of the well-being of social life in cities (Bourdieu, 1996; Madanipour, 1999; Schenker, 2002). For Jakarta, like other Southeast Asian cities like Bangkok (Thailand), Manilla (Philippines), or Kuala Lumpur (Malaysia), public spaces are not built, but rather a product of socially constructed in-between spaces where the public meets and exchange small, everyday interactions and transactions. (Miao, 2001). Examples of interactions in these developing cities are not unlike Gehl's (2013) typologies of activities of necessary, optional and transitory.

Earlier Table 1 also refers to how in each of the Suropati and Menteng park users can be differentiated by activities, sense of dress code, language spoken, and their public behaviour [on whether or not they adhere to the written rules imposed on both sites].It is noted in both parks that most visitors look, see their surroundings consistently, and maintain very strong eye contact with everyone they come in contact. Exchanges of waves and smiles, with occasional *"Mau minum?" (Do you need a drink?),* are very common from male park users [usually vendors looking for customers] but not always reciprocated or acknowledged by the female [unless it was also directed from another female from the research party].

Depending on the group size, again it usually the male that would be more dominant (in terms of identifying themselves: i.e. loud music, laughter and whistling) than the women will. However, in most of the observation periods, park users tended to focus on their own group and activities, not wanting to disturb others.

The city's relation to memory and perception through urban spaces

What can be seen through the observation phase of the fieldwork is that the selected public park of Taman Suropati and Taman Menteng becomes a place of community for those marginalized and most affected by the urbanization of the city. These include street musicians, vendors, the homeless people and sometimes groups of youth from the lower socio-economic background from the older, more derelict areas of the province. The public parks are the only areas of the cities where they [the

marginalised] are free to express their creative interests and regroup. However, with Indonesia's traumatic history with reformation and political conflicts in public spaces see Kusno (2004, pp. 2382–2383), much of the activities in the public space are still at in constant surveillance of the local governance.
Presence of armed and uniformed officers are also a common sight in the public spaces, even in the case study parks. In Taman Suropati, the proximity to the formal residence of the American Ambassador and the main office of Jakarta Governor means unified surveillance from many angles from areas adjacent to the park. These uniform men are either from SATPOL (Public Order Enforcers) or hired by the Park and Cemetery Agency of Special District Capital of Jakarta (Dinas Pertamanan dan Permakaman DKI Jakarta).

To preserve the peace and comfort of the many diverse populations Jakarta residents, the modifications and upgrade to Taman Suropati appears to be in the form of symbolic arts and cultural activities that the park offers. The walking path from south to the north of the park allows a view of six prominent artworks; three on the left and three on the right with each representing the symbolic friendship and diplomatic ties between Indonesia and its Southeast Asian Nations (ASEAN) countries. These six pieces include the *"Peace-Harmony and One"* by Lee Kian Seng (Malaysia), *"The Spirit of ASEAN"* by Wee Beng Chong (Singapore), , *"Fraternity"* by Nonthivathn Chandhanaphalin (Thailand), *"Harmony"* by Awang Hj Latif (Brunei),*"Rebirth"* by Luis E. Yee Jr. (Philippines) and *"Peace"* by Sunaryo (Indonesia). Each artwork lights up as shown in Figure 7.

Figure 6 Taman Suropati Map of symbolic art features (Source: Author)

Figure 7 Image is showing park users of Suropati on a Saturday night. Visitors are seen enjoying public space with family, friends and loved one despite not having seating arrangements provided. (Source: Author)

Influence of urban life to changing tradition and culture

Opportunities for livelihood and social ties work together in the context of the Indonesian society. According to findings of fieldwork (see Figure 7 and Figure 8), the general people are attracted to people, and word of mouth affirms trust and familiarity among the park visitors.

According to in-depth interviews with park vendors, much of the identification of indigenous culture that came along with the ethnic identities of the respondents still exists in the perception of other vendors [on conflict among the vendors].

However, informal economies such as food vendors and *"walking Starbucks"* are still considered to be part of "*multicultural heart of South East Asia*" identity that Jakarta has [quoted by respondent aged 55], not merely because of the attraction for international tourists, but because it encourages casual encounters between different ethnic groups who would otherwise not come into contact in this megacity. Such exchanges were seen as part of an everyday urban experience since the Dutch colonial era. It is this very every-day ordinary-ness of social mix that is considered the most valued aspect of the province of Jakarta.

Although activities such as public yoga classes, children's martial arts, health boot camps are a new addition to the 21st-century lifestyle, these activities are still part of an ongoing tradition held together by non-elected communities founded in the parks [Menteng and Suropati].

The role of the urban green spaces in everyday makings of the city

According to the interviews with respondents, trust and familiarity are the two important reasons why both case study parks are successful in provide a harmonious public space. Although only a small percentage of the respondents are regular visitors to the parks, the reputation and image of both case study parks proved enough to

secure and encourage future participations in both venues. From getting local favourites from the street carts of vendors, to allowing their children to join in the groups of sporting or cultural activities on site without planning or impromptu, it was not uncommon among respondents and park users to rely on the resources around the park for their regular needs.

Moreover, a high response rate for "enjoying physical presence of greenery and natural (or semi-natural)" in the multiple-choice question within the questionnaire was also one motivating reason behind going out and heading to the park. This response usually goes together with the popularity of social media such as Instagram, Facebook, or Twitter as it also gives an opportunity for photographic evidence for their social activities.

While it is acknowledged that enjoyment and well-being by a group of urban residents either enhance or come at a cost to the well-being of another group, balancing multiple demands between different users to ensure that some social groups are not side-lined should be an important policy goal for planners and managers. Yet, despite strict laws and presence of uniform security, the two case study parks have proven to be an important social platform, a place to start fostering communities between the urban residents of Jakarta.

The following quotes are from excerpts from the open-ended question on why respondents feel that there should be more encouraged social and cultural activities in parks like Taman Suropati and Taman Menteng;

"I like meeting up with my friends in here… (pointing over to a different park section-Taman Kodok on opposite street) … on that side they have a lot of food vendors...gathering chatting and eating at the same time. That is where I want to be."

(Respondent aged between 18-25) -Menteng Park

"It can be annoying to have them [the vendors and street musicians] but without them, it feels empty and lifeless. Doesn't feel like we are in Indonesia…"

(Respondent aged between 25-30)- Menteng Park

"the[this] park allows many chances to meet new people...even in my residential area, I don't really know about my neighbours."

(Respondent aged between 26-35) Suropati Park

" I rarely feel lazy to get to the park, although it is more [likely] that as long as I had friends to go with then I will, no matter where the park is."

(Respondent aged between 18-25) Suropati Park

Figure 8 Among the vendors interviewed in case study park parks during fieldwork March- April 2016 (Source: Author)

Figure 9 Suropati park users participating community activities on a Sunday afternoon (Source: Author)

Conclusive comments

The contribution of this study is to confirm the distinct characteristics of urban parks that play essential roles in supporting urban public life, especially in preserving local traditions of the people and encouraging connections between the diverse population. Moreover, this study contributes additional evidence that suggests the changing roles of spatial planning of green spaces in shaping in urban life, as they can be recognised as primary urban space, as public space, as creative space, as cultural space, and as an urban heritage that should be a mandatory part of city planning.

In summary, these results speak to the power of academic knowledge to structure the production of nature through local planning and interest in human ecology. To be able to plan for a highly populated country like Indonesia successfully, incorporation of personal histories of the residents needs to become a considerable part of the city makings for the future, considering experiences from all residents- regardless income or social status.

Acknowledgments

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[i] Shophouses- A vernacular building type commonly found in Southeast Asia usually two or three storeys. It comprises of a shop front in the groundfloor, with the upper levels designed for inhabitat.

Surviving at Fire and Post-Fire Debris/Mudflow Prone Zones in Colorado Front Range in Light of Feng-shui

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Abstract
Extreme climate patterns in recent decades have led to frequent fire events, rainstorms and debris/mudflows in Colorado Front Range, USA. The attractive landforms of Rocky Mountains coincide with these natural hazards. Once people settle in hazard prone zones, they are in danger. In many cases, the disastrous tragedies stem from design errors. These mistakes in practice reflect a weakness in education. Natural hazards are rarely emphasized in architectural education. Particularly, the topic of post-fire debris/mudflow is missing from the education of the site selection process. This research presents case studies of the high impact areas of the 2013 Colorado historic flood. The field investigations took place one year after the flood, and then again four years later. Following a fire event, debris/mudflows often occur in certain locations during intense and heavy rainfall. The mudflow and debris can run into a river or a lake, causing water levels to rise, which results in flooding. The post-fire debris/mudflow can also destroy hillside houses. Incorrect site selections can lead to disasters. Unfortunately, current insurance policies often require damaged structures to be rebuilt at the same site, which results in recurring damages due to consistent hazards. Learning from geomorphic studies and vernacular wisdom of *feng-shui*, Chinese geomancy, this interdisciplinary research on identifying landform patterns of high impact areas would help improve the site selection process, and accomplish appropriate warning systems and mitigation strategies. Ultimately, restraining people from settling in high impact areas is the most efficient strategy for mountain communities to survive and thrive.

Keywords: Natural hazard, Post-fire debris/mudflow, Landform patterns, *feng-shui,* Interdisciplinary education, Site selection

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Introduction

Extreme climate patterns in recent decades have led to frequent wildfires, massive rainstorms and subsequent debris/mudflows in the Colorado Front Range, USA. Climate change increases the global temperature, resulting in drier Colorado weather. Wildfires are a major threat to Rocky Mountain communities. Since 1970, the number of large fires per year has doubled and could increase another six-fold in the next two decades (Climate Central, 2013). In as soon as 50 years, the burn area could increase two to five times, engulfing almost all of the Rocky Mountain region (Baker, 2009).

Located immediately east of the Rocky Mountains, the Front Range is the economic and cultural center of Colorado. It spans to include the cities of Denver, Boulder, Fort Collins, Colorado Springs, and Pueblo (Figure 1). This region accounts for 82% of the state's population and creates 86% of its economic output (Summit Economics, 2009). As of July 1, 2015, the Front Range Urban Corridor supported 4,757,713 people, an increase of 9.78% since the 2010 United States Census. As the population of the Front Range grows, more people are moving into the wildland-urban interface zones, some of which are fire and debris/mudflow prone zones. As a result, human-caused fires have increased, and post-fire debris/mudflows frequently occur. The post-fire debris flow sequence has become a common phenomenon in mountain areas (Wells, 1987).

The debris flow, often referred to by the media as a "mudslide," can be a deadly disaster. Scientific institutions and governments currently research large-scale debris flows and develop mitigation plans. However, debris/mudflows occurring on local hillsides in wildland-urban interfaces are less researched. Local debris/mudflow events often occur suddenly. Recently, post-fire debris/mudflows in the West of the USA appear lacking an efficient warning system. Therefore, mountain residents are not prepared to deal with the impact and caught off guard. This research uses *feng-shui* as an indicator to identify the landscape patterns of the post-fire debris/mudflow prone zones in the Colorado Front Range, which could be used to develop warning criteria for residential evacuation.

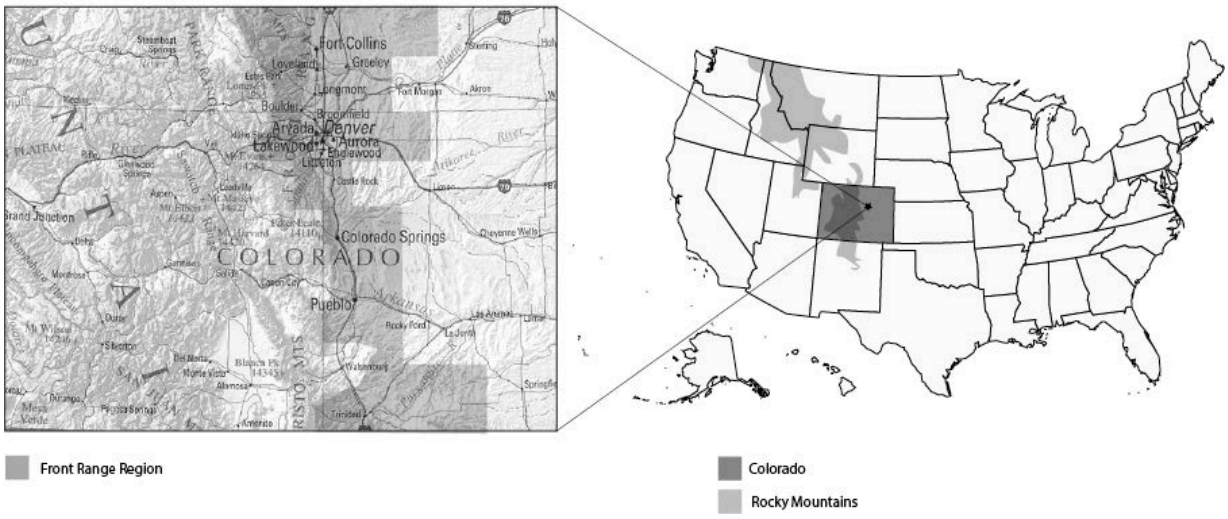

Figure 1. Location of Colorado Front Range. (Sources: Ann Dang; CSU, 2013; EB Inc., 2011; Simple Maps; UT Library)

The current extreme weather patterns that impact density development in the wildland-urban interface are new for most of us, therefore we lack the necessary experience and preparation. In order to adapt to climate challenges, we must first identify what the problem and impacts are, how the hazards progress, where the problem initiates, and where the high impact areas are. Vernacular methods may help identify these factors.

The Chinese have inhabited mountainous regions for thousands of years. Thirty percent of the Chinese population lives in mountainous areas, and two-fifths of the cultivated land is located in mountain regions of the country (Li, 2004). China's experience for thousands of years in adapting and surviving despite natural challenges are primarily summarized in *feng-shui* practice. *Feng-shui* is an ancient Chinese practice that harmonizes people with their environment. *Feng-shui*, directly translated to wind and water, is practiced at many scales, from mountain ranges and cities down to homes and furniture. *Feng-shui* has many schools; particularly prominent is the form school, which discusses landforms such as mountain/dragon, hill, water, and site. *Feng-shui* is used to select proper timing, a suitable location, and supportive people to sustain lives and communities by pursuing positive energy for good luck and disaster avoidance. Humans struggle to follow the laws of nature, which makes it difficult to survive in the natural environment. In Ian McHarg's book, "Design with Nature," he states that adaptations to natural laws to enhance life by promoting harmony between humans and nature (McHarg, 1969). Using the wisdom of *feng-shui* and geomorphic study we can further understand mountain disasters and identify the high impact zones in order to prevent tragedy within the mountain community.

Rocky Mountain Landforms Trigger Fire

The jagged peaks of the Rocky Mountains reach above 14,000 feet against the fair blue sky. The snow melts off the mountains into glacial lakes in which cold water fish abound. Small streams flow through canyons and verdant valleys. Forests with high tree lines above 10,000 feet brighten up in autumn. This beauty contributes to the popularity of the region but coincides with frequent natural hazards. In recent decades, these weather patterns are becoming more extreme. The 2013 historical flood killed ten people and caused nearly $4 billion in damage across 24 counties. There were 18,147 evacuees, 1,852 homes destroyed, and 28,363 homes damaged. Many of the mountainous areas experienced fire strikes before the flood, worsening flash flooding and debris/mudflows. Lightning strikes result in wildfires, which weaken the soil. If heavy rainfall follows these wildfires, flash flooding can occur, weakening the soil further and creating optimal conditions for debris/mudflows. Many members of the community, especially mountain residents, face frustration as they continue to deal with the flood's aftermath years later (Aguilar, 2016).

Fire Ecology and Post-fire Landscape

Wildfires are one of the most significant hazards in the Rockies. Fires are a major concern for residents until a few inches of snow cover the ground. Climate change and growing residential and visiting populations in fire-prone areas increase the overall likelihood of fires (Baker, 2009). According to the Intergovernmental Panel on Climate Change, warmer temperatures have also contributed to a longer and more destructive fire season. In the past 17 years, the fire season has extended by 78 days;

the number of fires has increased fourfold; the amount of time needed to extinguish the average fire takes five times longer; and the total burn area has expanded 5.7 times (Saunders et al., 2008).

The high peaks of the Rocky Mountain Range attract lightning strikes. Lightning, an electric discharge, causes fires by striking an earth-bound object. The smoke and mist expelled by a massive forest fire can cause even more electric charges, igniting new fires many miles downwind (Dul'zon, 1996). Between 2011 and 2016, three of the four largest by acreage fires were caused by lightning strikes. Although lightning can occur at any elevation, areas with steep slopes and high altitudes, often above 8,000 feet, attract the highest number lightning strikes. According to *feng-shui,* jagged mountain peaks with sharp slopes are called the fire mountains, because they experience frequent lightning strikes that spark the most fires (Jiang, 1997).

The Rocky Mountain range also triggers wind storms that spread fires over thousands of acres. Steep and rigid landforms of the Rocky Mountains at high elevations, particularly mountain crests, create these powerful wind gusts. The highest wind speeds tend to correlate with wildfires. Downslope wind storms are common in late autumn into spring along the Front Range. Downslope winds characterized by unseasonably warm temperatures are called Chinook winds, while Bora winds involve an influx of cold air and are accompanied by falling temperatures (Doesken & Roger, 2003). Canyons can form wind tunnels, increasing fire risk and spreading fire more rapidly. Colorado is the third most at-risk state for wildfires, due to the factors above (Insurance Information Institute [III], 2016). A primary criterion for site selection according to *Feng-shui* is to avoid high winds. It recommends that people do not build on the crest of hills because positive energy cannot accumulate, and strong winds will blow your good luck away.

In recent decades, the increasingly frequent fires in Colorado have led many residents to doubt the following academic theory: fire is an ecological system that plays a key role in shaping the natural landscape, and that this system should not be limited (Wuerthner, 2006). Colorado residents may align themselves more with Baker's conflicting theory: fires should be investigated on a large regional scale, with hundreds of years of temporal understanding, including the increasing human impacts on and from the system. He argues that policies should be shaped to protect the landscape and the people. In the past, fires have been seen as manageable ecological processes in a resilient ecosystem. In the Rocky Mountains, however, this idea is no longer tenable (Baker, 2009).

According to Baker, weather warming and expanding populations in mountain areas disrupt the natural cycle and substantially increase fire frequency and size. The Colorado Rockies have never experienced fire exclusion, as the Rocky Mountain landscape triggers fire events naturally. Colorado forests, in particular, take a long time to recover from fires. In the Rockies, there are few plants with seed banks to aid tree regeneration. The dry weather also impacts the recovery time; many forests are still recovering from the large fires of the 19th century (Baker, 2009).

Burned trees release large amounts of carbon dioxide and can no longer filter pollutants or produce oxygen. Inhalation of smoke and ash from large wildfires creates serious health threats for the elderly, ill, and those with heart or respiratory

conditions (Climate Central, 2013). Fires damage wildlife habitat, water quality, and mature forests and create carbon dioxide pollution. Also, the extended periods of recovery on burned slope sides leave them vulnerable to debris/mudflow disasters. Considering the potential impacts to ecological balance and human health, fires in the Front Range should be immediately extinguished.

Rocky Mountain Landforms Trigger Post-fire Debris/mudflows

Rainstorms

Intense and heavy rainfall is the pre-condition for debris/mudflows. Heavy summer storms often occur along the Colorado Front Range. Gulf/Subtropical Atlantic moisture merges with western winds crossing the state to generate extreme weather patterns before reaching the high mountains (Dust, 2016). Orographic lift, when the air is forced from a low elevation to a high elevation over steep terrain, also creates high precipitation storms in the mountains and canyons of the Front Range (Whiteman, 2000). Severe thunderstorms can spawn supercells, which can generate tornadoes or hail. The frequency of hail damage to crops in northeastern Colorado is quite high. With an average number of six or more hail days per year, some counties in eastern Colorado are among the most hail-prone areas in the country (Saunders et al., 2008). Another hazard related to heavy rainfall is flash flooding, including debris/mudflows. The greatest threat of flooding in Colorado is not from snow melt; rather, it is flash flooding from localized intense thunderstorms (Crespin, 2016). The intense rainfall triggered by the mountain landforms are instrumental to debris/mudflow disasters, therefore weather forecasting is a significant factor in predicting post-fire debris/mudflows.

Debris/Mudflows

Residents often think living in the mountains is a way to avoid floods, but there is another water hazard -- debris/mudflows, one of the most dangerous natural hazards in mountain communities (Reneau & Dietrich, 1987). In *feng-shui* terms, it is called the “water showering head” (Jiang, 1997) and is identified as one of the evilest and deadliest factors. Based on the geomorphic study (Onda, 2004; Clark, 1987; and Reneau & Dietrich, 1987) and the author's field investigations of 2013 Colorado debris/mudflow zones, the discussion of landform patterns emphasizes three areas. The first area is the debris catchment, including the basin, surrounding mountains, and canyons where debris and runoff accumulate and debris flows are initiated. *Feng-shui* refers to this area as the “dragon.” In particular, *feng-shui* recommends avoiding the mountain basins with debris, called the “sick dragon,” and canyons with steep slopes and a narrow channel, called the “violent dragon” (Figure 2). The Big Thompson Canyon, CO would be identified by *feng-shui* as a violent dragon. Several houses along this canyon were destroyed during the 2013 flood (Figure 3).

Figure 2: This diagram from an ancient *feng-shui* text book by Xu, Shike, represents the Violent Dragon. The black areas with zigzag patterns represent the mountain profiles, the fine lines represent the foothills, and the small circle represents the house site. (Source: Xu, Shike 1580. *Di Li Tian Ji Hui Yuan*, Chapter 5)

Figure 3: A dream of mountain living turns out to be a nightmare. This house in the Big Thompson Canyon was destroyed during the 2013 historical flood in Colorado. (Source: Ping Xu, 2014)

The second area is a debris flow track, which is often a water channel and the surrounding hillsides, where debris events develop, generate power, and accelerate downhill. Houses on hillsides should not be built on more than a 45% slope. According to *feng-shui*, a straight stream or river is evil, and a meandering stream or river is favorable. The area outside the meandering curve should be avoided. A dry wash with a narrow and straight channel that points directly at the site, known as a "hidden arrow," should be avoided as well. Hills with constant steep slopes, called "hills without veins," are subject to frequent flooding (Liu, 1986). The final area is the debris flow fan, a receiving or impact area, where the slope has dropped, and debris is released. *Feng-shui* recommends that the site selection process should encompass field investigations of surrounding landforms including mountains, canyons, hills, water, and the site conditions.

Postfire Debris/Mudflow Sequence

Following wildfires, there is often another hazard: The post-fire debris flow sequence. According to the author's field investigations of the 2013 flood impact zones in the canyons of the Colorado Front Range, every high-impact zone experienced a fire before the debris/mudflow, most within the three years prior. Fire changes the structure of soil, coating it in burned organic molecules and making it virtually waterproof. Two primary erosion processes cause debris flows in burned watersheds (Wells, 1987). The first process is dry ravel. The downhill movement of debris without the flow of water dams dry washes and worsens future flows. The second is the formation of rill networks--small debris flows that branch extensively with little rain. These erosions accelerate and intensify debris/mudflow disasters (Wells, 1987). After a wildfire, it is crucial to anticipate debris/mudflows. When fire burns vegetation from the mountainsides, it kills the ground cover and loosens debris. During heavy rains, the dead trees fall more readily, levering up the soil and producing more debris. The dead timber washes into a debris flow, further generating power. Geomorphic research indicates that in a debris/mudflow, a significant amount of heavy timber causes landslides and the destruction of property (Reneau & Dietrich, 1987).

Figure 4: Landform patterns of high impact areas of the 2013 flood. (Source: Xu, 2016a)

The author's field investigations indicate that the high-risk areas of the 2013 floods present similar landform patterns. These landform conditions led to the heaviest impacts in Jamestown and Drake during the 2013 Colorado mountain floods (Figure 4). The landform factors that create these patterns can be described as following: 1) The site, with a slope of roughly 10%, is located at a confluence area of the lower portion of a canyon, which forms a receiving zone for a debris/mudflow. 2) A small creek, originating several miles away, flows to the site through a "violent" or "ominous" canyon, which creates a zigzag shape. 3) The hillsides have a 25%-35% slope. 4) The narrow channel of the creek, which combines water, mud, sand, rocks, and dead trees, into a powerful debris/mudflow. 5) A river that points at the site and turns, called "water shooting heart" by *feng-shui,* which can have the power to destroy homes. 6) A steep hill north of the site, that experienced fires within a few years of the flood, leaving unstable soil and dead trees in its wake. These deposits developed into a local debris/mudflow that hit the site and fed into the river during intense and heavy rain.

The Big Elk Meadow, Lyons, was a high impact area of the 2013 post-fire debris/mudflows. Three lakes filled with mud, and many houses built on the lower hillsides or close to the lake faced flooding and debris/mudflow disasters. Additionally, a house that was affected by a fire ten years ago was destroyed completely by a debris/mudflow. In the summer of 2017, the author revisited the site. Surprisingly, a new house has already been constructed within 10 feet of the old damaged spot. This is because many existing insurance policies require damaged structures to be rebuilt at the same site, resulting in recurring damages due to landform patterns and the consistent hazards they present. Incorrect site selection can lead to disasters, and ignoring the disasters that occur does nothing to address the issue. In the next debris/mudflow disaster, it is highly likely the new house may face the same destruction as the last.

Wildland-Urban Interface Impacts

Tourism, outdoor recreation and an increasing residential population in remote areas have made housing prices skyrocket as the area sees increasing human demand. People and their infrastructure have been intruding further into the wildland-urban interface, severely impacting the sensitive Rocky Mountain landscape. Eventually, the continuous development of the wilderness will destroy the appealing qualities people initially pursued. Furthermore, dreams of mountain living can turn into nightmares without thorough preparation and adaptation to natural hazards.

Fire, wind, rainstorms, and debris/mudflows are natural processes. Once humans move into areas prone to these natural hazards, disasters can destroy human life and property. Colorado wildfires have impacted hundreds of thousands of acres of land, thousands of homes, and taken several lives. In this system, humans fall victim to disasters but are also a direct contributor to the dangers. Between 2011 and 2016, of the 108 wildfires surveyed, 60% were caused by humans. As the population of the Front Range increases, particularly in the wildland-urban interface zones, so will the development of homes and infrastructure, including roads and power lines. Large trees with shallow roots can be toppled by severe winds, damaging power lines and potentially lighting a fire that will spread rapidly by the winds. There is also an increase in mountain tourism with the growing population. Campfires can quickly spread out of control, which is often the cause of Colorado fires. 64% of human-caused fires during 2011-2016 within the Front Range area were over 500 acres. Due to the high rate of human-caused fires, fire prediction analyses should include the risk factor of human-caused ignition.

Once the vegetation is stripped through fire or erosion, there is opportunity for alien seeds to grow. These invasive species compete for ground cover against native plants, monopolizing topsoil and sunlight, which can easily change the mountain landscape and the ecosystem. Since these plants are aggressive and often overgrown, they are very easy to ignite, which can lead to large wildfires. Many mountain residents choose to inhabit the hazard zones to be near wildlife and to see wildlife, but in reality they are competing against these animals for territory. Bears commonly break into cars and houses for food and mountain lions threaten human lives. Human development and infrastructure in the wild eventually drive endangered species to extinction.

Mountain residents desire privacy and their individual freedom. To have their own territory, some are willing to pay a high price and build a long driveway. Construction projects in the mountains alter the original terrain and drainage systems and often cause erosion. During heavy rainstorms, debris/mudflows can occur. Evacuating people and their pets from remote areas during fires and debris/mudflows is often very expensive, sometimes requiring helicopter assistance, and can also risk the lives of firefighters. The development of the wildland-urban interface negatively impacts the Rocky Mountain ecosystem and leads to more losses during natural disasters.

Conclusions

Faced with natural disasters, humans respond with three main attitudes. The first attitude is over-optimistic; the belief that humans can have power over nature. When nature causes trouble, these people want to "beat mother nature back." However, increasingly frequent natural disasters around the world have forced people to accept that nature is more powerful than humans. The second attitude is over-pessimistic; the feeling that natural disasters are out of people's control, creating resistance to acknowledging the issue. The people with this mentality simply hope that natural disasters will not happen during their lifetime. The third attitude is that we must adapt to climate challenges to sustain our society. As Darwin posited, "*It is not the strongest of the species that survives, nor the most intelligent, but rather the one most adaptable to change"* (Darwin, 1909).

Natural systems move in periodic cycles, with good years and bad years. We have to learn to survive with natural hazards. Climate, along with racial inheritance and cultural development, ranks as one of the most crucial factors in determining the conditions of civilization (Olgyay, 1963). Natural hazards are dangerous for humans, but they are part of the ecological process. Once people settle in hazard-prone zones, they are in danger. In many cases, the disastrous tragedies stem from design errors, particularly poor site selections. Throughout history, architecture and environmental design have developed with survival strategies impacted by the forces of climatic disasters. The current fire and post-fire debris/mudflows would teach us how to survive with these hazard challenges.

According to the author's field investigations of the 2013 flood impact zones in the Colorado Front Range canyons, every high-impact zone experienced a fire before the debris/mudflow. According to the geomorphic research by Wells, fire changes the structure of soil, coating it in burned organic molecules and making it virtually waterproof. The primary post-fire erosion processes include the dry ravel -- the downhill movement of debris, which dams dry washes and worsens future flows; and the rill networks--small debris flows that branch extensively with little rain. These erosions accelerate and intensify debris/mudflow disasters during intense and heavy rainfall (Wells, 1987). After a fire, it is crucial to anticipate debris/mudflows.

Identifying landscape patterns of high impact areas of post-fire zones would help us to establish the criteria of a warning system to evacuate people from the most dangerous zones of post-fire debris/mudflows. The impact zones can be identified through three pre-conditions: 1. The landforms trigger debris/mudflows. A debris/mudflow often initiates from steep uphill landforms and basin areas in higher elevations abound with debris. The debris/flow then accelerates and generates power through a narrow

channel/canyon, continuing to erode the surrounding land and accumulate debris. When the slope suddenly declines, the debris is released with the greatest impact. The high impact area is in the lower elevation, also including some hillsides; 2. The area experiences a wildfire strike, particularly at a higher elevation, which accelerates and amplifies the debris/mudflow process; and 3. The impact zone, including the higher elevation area, receives heavy and constant rainfall.

The information from the three pre-conditions contributes to the predictability of the post-fire debris/mudflow warning method. First, after a wildfire, all areas are well mapped by government institutions. Second, by following the criteria of landscape patterns, the potentially dangerous zones of debris/mudflows can be identified. These areas can be mapped manually or by digital GIS mapping. Third, the reliable weathercast system provides warning for heavy and constant rainfall. Therefore, after a wildfire, the local government should warn people to be prepared for a post-fire debris/mudflow strike. When weather forecasting reports heavy and constant rainfall, people living in the hazard-prone zones should be asked to evacuate immediately before the storm, as the post-fire debris/mudflow can be too fast to escape. It is common for flooding to occur after a wildfire, as debris flows into creeks and rivers, raising the water level. The debris/mudflow on the hillside also can also be a deadly disaster: Leveling houses, toppling trees, and in worst case scenarios even taking lives.

Humans have inhabited mountains throughout history. Over generations, they learned how to survive in challenging environments. A wise site selection would help people to avoid danger. Combining scientific study and *feng-shui* practice, the following criteria would help people to select a site for their mountain home, and provide specific factors to identify the potential hazard zones of post-fire debris/mudflows.

Mountain range and canyon (Dragon). First, people should look and evaluate the mountain range and canyon. *Feng-shui* refers to this area as the "dragon." In particular, *feng-shui* recommends avoiding the mountain basin with debris, the "sick dragon," and the canyon with steep slopes and a narrow channel, the "violent dragon."

Hills. Housing in hilly regions should be constructed with caution. Areas above 8,000 feet in elevation, particularly on mountain crests and hill peaks, are susceptible to lightning, high winds, and wildfires. Furthermore, steep slopes over 25% grade, mountain basins, and downhill areas should be avoided because they can trigger debris/mudflows. People should evacuate from houses built on the lower end of a straight gulley, or with a dry wash behind or directed towards the site, referred to in *feng-shui* as "the hidden arrow" (Xu, 2016b).

Water: river, creek, and dry wash. *Feng-shui* advises people to avoid construction on sites near water because of its vulnerability to debris/mudflows and floods. Houses should not be constructed near the confluence of two rivers. Sites outside the curve of a river with a channel pointing directly at the house, called "water shoot the heart" in *feng-shui*, are particularly dangerous and residents should prepare for evacuation in the case of a debris flow.

Site. *Feng-shui* also advises people to have a comprehensive analysis of the surrounding landforms. Flat areas that have a 10% slope on the downhill side of a

creek or dry wash can be a receiving or impact area of debris/mudflows. Low points in the landscape are susceptible to flooding. Dense forests have a high risk of wildfires. Additionally, the highest impact areas often have the combination of landform patterns: a zigzag canyon with a hillside over 25% grade, a river that flows toward the site, the confluence of two rivers, and a local steep hill that was recently affected by a fire. People located in such areas should immediately evacuate after preconditions are observed.

Natural hazards are dangerous for humans, but they are part of the ecological process and only become disasters when they affect human life and property. With increasingly extreme weather conditions and growing populations, Colorado wildfires and post-fire debris/mudflows will continue to occur frequently. Nature is hard to control, but human behavior can be modified. Human development and populations are impacted by, but also contribute to, the causes of these disasters. The wildland-urban interface expansion negatively impacts the Rocky Mountain ecosystem and results in more damages from these hazards. Pushing populations and infrastructure away from hazard zones and ecologically vulnerable areas would be an effective strategy for adapting to climate challenges and sustaining the Rocky Mountain ecosystem for future generations.

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Conceptualizing Media Health Literacy in Thailand: Bridging between Media and Health Concepts

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Abstract
A concept of health literacy has been addressed for a period of time and is continuously reviewed, redefined, and used as a variable in health behavior researches. Many studies indicated health literacy as a determining factor of health behavior, namely that health literacy is associated with a variety of adverse health outcomes. The widely used definition of health literacy is "the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions". From the definition, media is inevitably a necessary element of health literacy. Besides, media scholars introduce a related concept called media literacy referring to the ability to access, analyze, evaluate, and create media, and health media is also entailed. However, the relation between these two terms are less articulated, especially in Thailand, to understand the role of media as a source for providing health information and an influential factor for promoting health literacy. This article explores and clarifies the relevance between health literacy and media literacy definitions and also proposes a conceptual idea for redefining the term 'media health literacy' and its dimensions in the Thai context. The measurement of media health literacy is also criticized in the article.

Keywords: health literacy, media literacy, media health literacy

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Introduction

The Statute on the National Health System B.E. 2552 of Thailand defines "health" as the state of human being which is perfect in physical, mental, spiritual, and social aspects, all of which are holistic in balance. Dr Prawase Wasi explained each of the four aspects as follows: 1) physical wellness is to have a healthy body, to live safely with four basic necessities of life, and to be free from poison; 2) mental wellness is to have virtue, gracefulness, peace of mind, and intelligence; 3) social wellness is to live together peacefully within a strong and fair community; 4) spiritual wellness is to have knowledge, literacy, harmony, and freedom. Given those definitions, health is composed of physical, mental, and social well-being. To have good health is one way to achieve happiness and success in life and health literacy is the key and foundation to that goal.

Health literacy is related to health outcomes, which include holistic health status, diabetes control and HIV infection control, and health services, which include flu vaccination, sexual transmitted disease screening, access to hospital treatment, and health expenditures (Health Education Division, 2011). A number of studies indicated relation between health literacy and health behavior. Health literacy can also solve and reduce health inequality problems because the people will have comprehension about changing physical and mental diseases and be able to avoid health risk to spare themselves the burden from getting access to healthcare such as spending on medical services and medicines. At the same time, it can lessen the workload of hospitals and health service centers and lower the state's healthcare treatment expenditures, which will allow the country to use the budget for promoting health and preventing diseases instead. Manganello (2008) divided health literacy into four levels: functional health literacy, interactive health literacy, critical health literacy, and media health literacy. Taking into account the influence of media on individuals nowadays, media literacy is included as part of health literacy development for the media plays an important role in communicating health information.

Media scholars have introduced a media literacy concept, which generally refers to the ability of citizen to access, analyze, and produce a variety of information. Media literacy study is related to many fields of knowledge such as pragmatics, history, science, and technology, so to study media literacy in the context of health also includes the study of the influence of media content presentation on an individual's health such as regarding dietetics, gender, alcohol consumption, and smoking behavior.

However, health literacy and media literacy studies by medical and public health scholars and media scholars these days have not much addressed the integration of health and communication science in developing measurement of media health literacy and finding indicators of relations among public health knowledge, media use skill, and the media's role in providing health information to create good health behavior. Moreover, the relations between health literacy and media literacy are less articulated, especially in Thailand. This article aimed to review the concepts of literacy, health literacy, and media literacy to find their relations, study health literacy researches in Thailand to suggest a concept of media health literacy, and provide a guideline of media literacy measurement for using in the study of media's role as a source of health information.

The relevance of health literacy and media literacy definitions

To understand the concept of health literacy and media literacy should start from historical review of the evolution of the definition of literacy. Literacy has traditionally been thought of as reading and writing. Although these are essential components of literacy, the understanding of literacy today is changed. Berkman et al. (2010) reviewed the definitions of literacy in the United States and concluded the evolution of literacy definitions, that the meaning of literacy was changed from being able to sign a document and read and write in own language to functional literacy which required school training with at least a high school diploma. Post-secondary education is necessary at present. An individual's ability to read, write, and speak in English and compute and solve problems at a level of proficiency is necessary for functioning on job and in society, achieving one's goal, and developing one's knowledge and potential. In addition, data in the past 20 years showed relations between low literacy levels and poor health status and health outcomes. This led to growing studies in those issues and subsequently the emergence of a new field of study called health literacy (Berkman et al., 2004).

The concept of health literacy was first introduced in a document from an academic seminar on health education in 1974 (Mancuso, 2009). Yet, there is no consensus about the definition of health literacy. The World Health Organization or WHO (1998) defined health literacy as "the cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health". The Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs of the American Medical Association or AMA (1999: 553) referred to health literacy as "a constellation of skills, including the ability to perform basic reading and numerical tasks required to function in the health care environment". In Thailand, health literacy is defined as the ability and skill of an individual to access information, knowledge, and understanding for analysis, assessment, and management of oneself and the ability to give health advice to a person, family, and community for good health (Health Education Division, 2011). Accordingly, a general definition of health literacy is "the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions".

Nutbeam's prototypical model (2008) divided health literacy into three levels: 1) functional health literacy – basic skills of reading and writing that are necessary for functionally effectively in everyday situations; 2) interactive health literacy – more advanced cognitive and literacy skills which, together with social skills, can be used to actively participate in everyday situations, extract information and derive meaning from different forms of communication, and apply this to changing circumstance; 3) critical health literacy - more advanced cognitive skills which, together with social skills, can be applied to critically analyze information and use this to exert greater control over life events and situations.

Manganello (2008), seeing the importance of the media, both offline and online such as websites, social networking sites (SNS), and mobile applications, as a source of health information, subsequently added a dimension of media health literacy as an ultimate level of health literacy. Media literacy is referred to as the ability of an individual to analyze, evaluate, and interpret media content. Therefore, media literacy

is related to health literacy and changes of health outcomes can result from health education and health communication activities.

According to Hobb (2003), media literacy consisted of 1) the ability access messages, which includes skills of decoding symbols and understanding vocabulary and skills of understanding hyperlinking and digital space and using effective search and find tools, 2) the ability to analyze messages, which includes skills of comprehensive understanding, classifying concepts, giving rational opinions, understanding strategies of a message, and identifying a purpose and point of view of a message, 3) the ability to evaluate messages, which includes skills of assessing a relation and value of a message to the readers, interpreting a message, and predicting an outcome or reaching a logical conclusion from a message, and 4) the ability to communicate messages, which includes skills of understanding the other side of the communication, using symbols to convey meanings effectively, and creating messages via an appropriate form of media.

Interestingly, media literacy is not only limited to school training but lifelong learning from childhood to old age. For this reason, media literacy promotion starts from a family; parents should act as good examples of how to use media for their children. When it comes to an education system, teachers should add knowledge about media literacy in their lessons, teaching students to ask questions, analyze, and evaluate media content. At the same time, media producers should adhere to the code of ethics in working and media regulators should have policies to encourage good media and counter the media that promotes negative value and behavior.

Although the definitions of health literacy and media literacy are closely intertwined, in practice public health personnel who have insights into health information and media personnel who are expert in communication and understand the influence of media still work separately to develop good health for people in the community. Therefore, relevant personnel from the public health and media sectors should have mutual understanding about health and media literacy to encourage and develop media literacy in the society.

Influence of media on health

Media can have an influence on a person's health in many aspects. Mentally, media presentation can affect a person's satisfaction or dissatisfaction with consumption. Physically, media content can lead to desirable or undesirable changes in a person's health behavior. And intellectually, media can create demands for goods and promote materialism in the society.

Overseas studies about the influence of media on health showed adverse impact of media such as aggressive and violent behavior, sexual behavior, self-image perception, malnutrition, obesity, drug use, alcohol consumption, and smoking behavior (Bergsma & Carney, 2008). Media content can have effects on the development of health-related attitude, habit, and behavior of adolescents, which can continue in adulthood. There were empirical evidences that media had positive or negative influence on a person's self-image perception, eating behavior, and self-respect (Smolak & Stein, 2006; Tiggemann & Miller, 2010, Utter, Neumark- Sztainer, Wall, & Story, 2003, Frisén & Holmqvist, 2010). A study showed that adolescents with low health literacy were prone

to risky health behavior and diabetes and had little good health behavior (Conwell et al. 2003, Sharif & Blank, 2010, Chang, 2011). In addition, while those providing health knowledge and state agencies providing healthcare services were trying to use the media to promote good health behavior, advertisers only focused on increasing consumption to boost profit (Wilmot, Begoray, & Banister, 2013).

As negative effects of the media are inevitable, it is necessary to create immunity and at the same time increase positive outcomes from media use. Therefore, media literacy is an important and vital skill that should be developed in people. To be media literate, an individual will be able to access health-related content, protect oneself from being motivated by content, critically analyze and interpret the content one has watched, listened, or interacted with, apply the content, and creatively create and disseminate media. Accordingly, the practical and most effective approach is to promote media health literacy, which is an integration of health literacy and media literacy.

Studies and measurement of health literacy

During 1999-2009, the number of research articles and studies on heath literacy in Thailand had increased. Most of the studies targeted adults, followed by the elderly, children, and the adolescent, respectively (Kwanmuang Kaeo-dum-koeng, cited by Health Education Division, 2011). In fact, however, health literacy is important to people of every age group, especially media health literacy, for the media is a big source of health information, which is provided directly in a form of health content and indirectly via other content such as TV series, movies, advertisements, and news.

The evaluation of health literacy had been undertaken in many target groups by many health agencies and scholars. Yet, the indicators of people with poor health literacy in some studies are informal. For example, patients reported that they failed to complete registration form, were unable to name medications or explain their purpose of dosing, identified pills by looking at them but not reading the labels, and repeatedly used statements like “I’m too tried to read” when asked to discuss written materials. In contrast, formal evaluation is usually based on measurements like Rapid Estimate of Adult Literacy in Medicine and Dentistry (REALM-D) which assesses a patient’s ability to understand medical terminology and Test of Functional Health Literacy in Adults (TOFHLA) which assesses reading comprehension and numeracy in common medical scenario and materials. Nevertheless, health literacy measurement does not only assess reading, writing, and understanding skill of a patient but also the ability to comprehend, analyze, interpret, and evaluate the received content. Still, measurement of health literacy in relation to media literacy is limited.

Therefore, Levin-Zamir (2011) had developed a model and indicators of media health literacy, arguing that existing models of health literacy were not systemically adapted to create sufficient understanding about media as a source of health information. Levin-Zamir suggested four levels of media health literacy: 1) content identification – the ability to perceive health information to which one has access and disseminate it to others; 2) perceived influence on behavior – the ability to realize how health information presented by the media affect behavior of message receivers; 3) critical analysis – the ability to critically analyze media content for its purpose and hidden

value, attitude, or intention; 4) intended action/reaction – the ability to consider what should and should not be done based on heath information presented by the media and show action/reaction.

Higgins & Begoray (2012) established a similar concept called critical media health literacy, which is a combination of health literacy, critical health literacy, media literacy, critical media literacy, and critical appreciation, to encourage good health status. Therefore, media health literacy measurements should be developed to reflect factors that have impact on media health literacy, the role of media on health belief, attitude, and behavior of the audience, an individual's response to the media, and media health literacy of the people, especially the youth, to cover every dimension of health literacy to be used for promoting quality of life of the people.

This study aimed to explore primary health literacy researches in Thailand in both broad and deep approaches to see an overview of health literacy studies, explore health literacy researches that had adopted a concept of media literacy in the study to provide suggestion for a development of media health literacy concept as an interdisciplinary field, and measure the level of media health literacy among the people to collect useful information for the reduction of health risk and an improvement of quality of life of the people.

Methodology

The population of this study was health literacy research papers in Thailand. The samples were sorted via the Thai Library Integrated System (ThaiLIS), an online research database which provides access to full researches and dissertations from nationwide universities, targeting research papers in the past ten years (2008-2017). The keyword used was health literacy.

From the 29 samples (21 dissertations and eight researches) sorted, 2010 was the only year that showed no searching result on that keyword (Figure 1). Content analysis included research objectives, research subjects, theories used, methodologies used, samples, health literacy measurements, and health literacy levels.

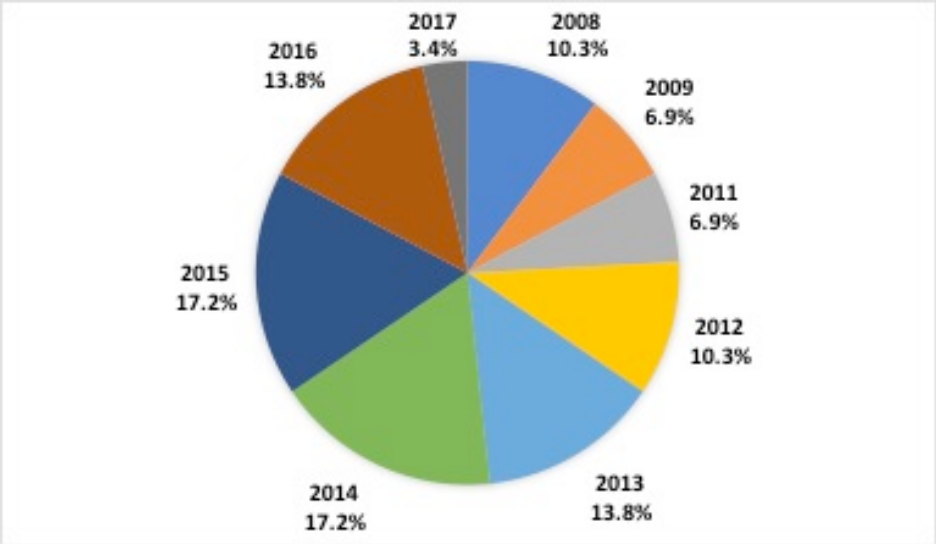

Figure 1: Numbers of researches by year

Results

From the 29 samples, all researches aimed to describe the variables of the study (n=29, 100%). Twelve of which (41%) also aimed to find relations between variables such as demographic data and health behavior, health literacy and health behavior, and knowledge about diseases and treatment and continuity of medicine taking.

Speaking of research subjects, most of the studies (16 articles) concerned general health, followed by high blood pressure (three articles), obesity (two articles), and the rest as follows (Table 1).

Subject of Study	Numbers of Articles (%)
General health	16 (55.2%)
High blood pressure	3 (10.3%)
Obesity	2 (6.9%)
Heart failure	1 (3.4%)
Type 2 diabetes	1 (3.4%)
Eye surgery patients	1 (3.4%)
Sexual transmitted diseases	1 (3.4%)
Cervical cancer	1 (3.4%)
AIDS	1 (3.4%)
Dengue hemorrhagic fever	1 (3.4%)
Drug abuse	1 (3.4%)
Total	**29 (100%)**

Table 1: Research subjects

In terms of theoretical framework, 23 studies (29.3%) reviewed health literacy concept in literature review, three studies (10.3%) reviewed media literacy concept, and only two studies (6.8%) reviewed both health literacy and media literacy. Other theories used (n=14) concerned specific diseases or health context such as healthcare system, self-care, uses and gratification of health media, and addictive substance.

Most of the researches (n=24, 82.7%) used a survey method, followed by interview (n=5, 17.2%), document analysis (n=3, 10.3%), experiment (n=3, 10.3%), and group discussion (n=1, 3.4%) (Table 2). Interesting, as much as 65.5% (n=19) used only a survey method as a research tool, while 17% (n=5) used mixed methodologies.

Methods of Study	Numbers of Articles
Survey	24 (86.2%)
Interview	5 (17.2%)
Document analysis	3 (10.3%)
Experiment	3 (10.3%)
Group discussion	1 (3.4%)

Table 2: Research methods

In the study of health literacy, the most studied samples were patients (n=8, 27.6%), followed by universities students, the elderly, other specific groups which were female sex workers, public health volunteers, and monks (n=4 for each), and others (n=2, 6.9%).

Regarding measurement of health literacy levels, 11 studies measured health literacy in general and used the measurement tools developed by former researches or standardized tests of functional literacy like the Rapid Estimate of Adult Literacy in Medicine (REALM) and the Test of Functional Health Literacy in Adult (TOFHLA), while the rest used own-developed measuring tools. One study also aimed to develop indicators of health literacy.

Of the 22 articles measuring health literacy levels, the measurement can be divided into two groups. The first group measured health literacy levels based on the degree of literacy; most of the samples showed moderate health literacy (n=7, 24.1%), followed by high health literacy (n=5, 17.2%). The second group measured health literacy levels based on the adequacy of literacy; three articles showed adequate literacy (n=3, 10.3%), while seven articles did not directly measure health literacy but measured the use of media for health information instead.

Variables that affected health literacy included education levels, access to the information, as well as some other demographic variables. In addition, health literacy correlated with health-promoting behavior and disease protection behavior. However, some of the researches studied the use of media for health purposes such as for finding health information and the opinion about media benefit, but did not clearly indicate the interaction between media and health content and health behavior of the audience.

Level	Numbers of Articles (%)
Degree of Health Literacy	
High	5 (17.2%)
Moderate	7 (24.1%)
Low	5 (17.2%)
Adequacy of Health Literacy	
Adequate	3 (10.3%)
Inadequate	2 (6.8%)
Not available/not measured	7 (24.1%)
Total	**29 (100%)**

Table 3: Levels of health literacy

Conclusions

Health literacy is a term first introduced in the 1970s and has become increasingly important in the fields of public health and healthcare. Health literacy is related to the capacities of people to meet the complex demands of health in a society. Findings from this study showed that health literacy has positive relations to health-promoting behavior. In addition, increasing health literacy is essential to promoting and maintaining good health of individuals and communities and lowering medical care expenditure, and is linked with the economic growth and socio-cultural and political changes.

Media health literacy is not just an interesting concept for public health or medical personnel whose responsibility is to provide health knowledge to the public, but also among media scholars who are finding effective strategies for providing people the

information about ways to enhance health or avoid specific health risks. And due to the growing interest in health literacy both in the medical and communication context, the conceptualization of health literacy should be redefined to reflect the concept validly.

The study showed that most health literacy researches in Thailand unusually used existing measurements, which included standard tools like the REALM and the TOFHLA and applied tools for particular cases such as obesity and eye surgery. The tools assessed a patient's ability to read and understand health information (Berkman et al., 2004) and numeracy in common medical scenario and materials. These assessments, however, are not considered comprehensive measures of the skills needed by individuals in the health care environment.

In addition, the results from the synthesis of this study suggested that, even though media literacy and other media variables were included in some health literacy research, it was still less articulated how an individual interacts with health information received from the media such as linking of content to oneself, content evaluation, and acceptance and application of the content. Accordingly, a group of scholars induced a concept of media literacy which integrated health literacy with communications, adding media literacy as another dimension of health literacy skill (Nutbeam, 2008). There were also attempts to develop a concept that intertwined health literacy with media literacy such as 'media health literacy' concept introduced by Levin-Zamir (2011), which consists of content identification, perceived influence of media on behavior, critical analysis, and intended action/reaction (personal health behavior).

In conclusion, development of media health literacy measurements in Thailand is important for the improvement of an individual's abilities and skills in a modern health context. Basic skills of reading and writing (functional health literacy) are necessary, but evaluation and critical skills are even more important for detecting adverse effects from health information. At an individual level, ineffective communication caused by poor health literacy will result in poor quality and risk to one's safety of healthcare services, health prevention, and health promotion. At a population level, health literate people will be able to engage in ongoing public and private activities about health, medicine, and health cultural beliefs. High media health literacy will increase personal empowerment and will be seen as a part of an individual's development towards a better quality of life. In the population level, it may also lead to more equity and sustainability of changes in public health. Consequently, improving media health literacy should be addressed as a social agenda.

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The Economic Evaluation of the Pastureland of the Kyrgyz Republic

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Abstract
This paper estimates the economic value of the pastureland in the Kyrgyz Republic. The agriculture sector of the Kyrgyz Republic, especially livestock grazing, faces a challenge of pasture overgrazing and the declining productivity of the pastureland. Heeding on the sustainability policy of the Kyrgyz Republic, this study tries to find out if it is possible to better estimate the value of the pastureland as natural capital and quantifying its economic benefits, given limited data on the natural environment in the Republic. This research examines the applicability of the System of Environmental-Economic Accounting (SEEA) methodologies, a newly developed United Nations initiative. It first examines different methods of the SEEA and how the pastureland accounting, which has not been done yet previously, can possibly help estimate the environmental stock and flows of the natural capital. It further analyzes the ecological consequences and benefits.

Keywords: Natural capital, System of Environmental-Economic Accounting, Ecosystem accounting, Overgrazing

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1 Introduction

In 2012, the UN Statistical Commission adopted the System of Environmental-Economic Accounting-Central Framework (SEEA-CF) to aid countries to statistically describe the interactions between the economy and the environment by linking indicators of national accounts with environmental factors. This new system basically incorporates physical natural assets, and records physical quantities of natural inputs to the economy. It identifies residuals produced and consumed (and by whom) as well as changes in private and public natural assets. SEEA account structures are closely aligned with those of national statistical frameworks. This makes the linking to national accounts possible. One year later, the UN also released another version, the SEEA Experimental Ecosystem Accounting (SEEA-EEA) to complement the Central Framework (UN et al., 2014).

More than 55 countries initially expressed interests in this accounting system, including the Kyrgyz Republic, where overgrazing and deforestation have led to the disappearance of important pasture plants, plant resources, and soil erosion. About 29% of pasturelands were at a middle and high level of degradation (Penkina, 2014). The summer pasture yield decreased from 8.6 dt dry matter (DM)/ha in the early 1970s to, 5.7 dt DM/ha in the 1990s, and 3.1 dt DM/ha in 2004. In the last 50 years the yields from summer and winter pasturelands have decreased by about three times. This means that about 11.5 million tons of natural forage was lost annually (MoA, 2012).

In order to fully understand what this decline means for Kyrgyz Republic decision-makers, this paper argues that the System of Environmental-Economic Accounting (SEEA) can be a useful tool for the pastureland capital valuation. The SEEA also can be applied to the Kyrgyzstan's System of National Accounting (SNA) to produce a set of microeconomic indicators, which is a common tool for decision makers.

2 Research Objective

The pastureland is one of the most important natural capital for the Kyrgyz Republic, and it is imperative to estimate its values. The objective of this research, therefore, is to examine the soundness of the SEEA in doing so. As the SEEA is relatively new tool with limited published results, the following discussion first introduces the past relevant results from Australia. Then we discuss how the value of the pastureland in the Kyrgyz Republic can be better captured by using two major methods of the SEEA.

3 Cases of SEEA implementation

3.1 Australian Land SEEA

In order to find out if the SEEA can be a useful tool for numerically describing pastureland benefits in the Kyrgyz Republic, it is important to find out how it has been used by some countries. Then we can better grasp the potential benefits arising from this statistical framework for better policy options. One of the advanced SEEA

applications has been observed in Australia. This country is similar to the Kyrgyz Republic to some extent as it emphasizes pastureland and livestock grazing. Using the SEEA, the Australian Bureau of Statistics estimated that the total value of natural capital in Australia was AU$ 5.836 billion, of which the land had the greatest value at 81% or AU$ 4.722 billion in 2015 (ABS, 2017)

So far, no SEEA focused only on pastureland. The closest available results are land accounts that measure integrated features of land, and describe how these features can be changed over time. Land accounts inform decision-makers for land management and the sustainable production of goods and services (ABS, 2011). They can also inform the public about the productive capacity of land across different industries, and the impact of different land management decisions on the carbon cycle and water availability.

Australia's land accounts in the SEEA Central Framework (SEEA-CF) focused on the Flinders–Norman rivers catchment in northern Queensland. Three types of output reports were presented: a basic stock table, a change (flow) matrix, and a change (flow) map. For the land cover classification it adopted the international standard called the Land Cover Classification System (LCCS), which was developed by the United Nations Food and Agriculture Organization. The classification was done on the basis of primarily non-vegetated land and primarily vegetated land. The latter lands are further divided into different categories based on vegetation (Bureau of Meteorology, 2013: 122).

3.2 Fast-tracking Forest Accounts in the Kyrgyz Republic

The Kyrgyz Republic is one of the pilot project countries for the SEEA. Partly to deal with overgrazing and deforestation, the Kyrgyz government established a national sustainability strategy and entrusted the Ministry of Economy to undertake this policy. Efforts for "green growth" are under way with the establishment of green growth indicators.

In 2015, the National Statistics Committee of the Republic made the first attempt to make SEEA Experimental Ecosystem Accounts (SEEA-EEA) for forest provisioning services. Whereas the Central Framework focuses on the economic units and incorporates environmental inputs, the Experimental Ecosystem Accounts focuses on ecosystem aspects and attempts to connect them to economic units. Since 93% of the country's area is mountainous, the Kyrgyz Republic needed the forest-based or ecology-based accounting system to reduce natural disasters like landslides.

The results highlighted the previously ignored contribution of forests to Kyrgyzstan's gross domestic product (GDP). When the value of non-timber forest products are included in GDP, the contribution of forest products increases by 25 times from 0.05% to 1.24%. These experimental environmental accounts provide the basic guideline to improve and integrate with official data flows to the SNA of the Kyrgyz Republic (NSC, 2016).

4 Using Environmental Accounts

4.1 The Ecosystem Model Concept

The SEEA-EEA the Kyrgyz Republic used for forest accounts consists of five main components (Figure 1). The first component is the ecosystem asset in a spatial area. Different types of ecosystem assets exist within a territory. Second, every single ecosystem asset contains a set of relevant (2) ecosystem characteristics and processes. This implies ecosystem functions. This means "the stock and changes in stock of ecosystem assets is measured by assessing the ecosystem asset's extent and condition using indicators of the relevant ecosystem asset's area, characteristics and processes" (UN, 2017). Third, each ecosystem asset provides a set of (3) ecosystem services. Fourth, the ecosystem services contribute to (4) the production of benefits. Benefits are represented by goods or services (products) the SNA (e.g. timber products) recognizes. The SNA terms those that are not produced by economic units (e.g. clean air) non-SNA benefits. Finally, both SNA and non-SNA benefits contribute to (5) individual and societal well-being (UN, 2017).

Marketable ecosystem goods and services are considered in market transactions of ecosystem assets, but non-market ecosystem services (e.g., soil carbon sequestration) are not generally be considered by the buyer or seller of an ecosystem asset (Hein et al., 2016). The concept of ecosystem capacity can be directly linked to the measurement of ecosystem degradation (UN, 2017).

From an accounting perspective, the ecosystem capacity measurement is based on the link between ecosystem capacity and ecosystem degradation (UN, 2017). In the SEEA-EEA, ecosystem degradation is defined in relation to the decline of an ecosystem asset condition that is affected by human activities (UN, et al., 2014)

The UN Technical Recommendations for the SEEA-EEA (UN, 2017) offers four main approaches to measure degradation: (1) in physical terms through changes in ecosystem condition indicators; (2) in monetary terms through changes in the net present value (NPV) of the actual use of ecosystems; and (3) in monetary terms through changes in NPV of capacity. Note that a fourth potential option is available: (4) through changes in the NPV of the potential supply. The fourth approach may require the attribution of monetary values (i.e. option values) to ecosystem services that are currently not used. The latter two approaches to define degradation are unlikely to be relevant for accounting.

The ecosystem contributes to the changes in wealth at the national level. This means the data from SNA accounts are important to integrate the information about ecosystem services, goods and asset.

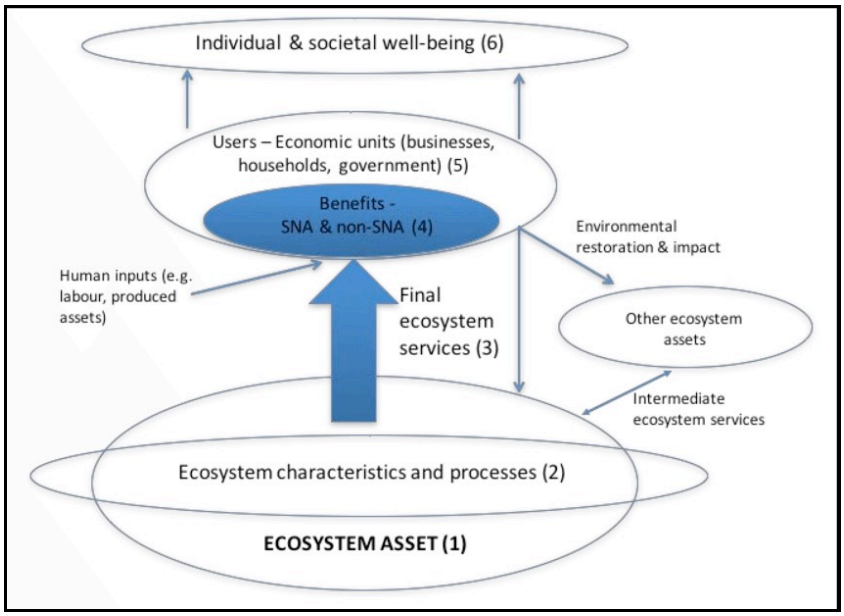

Figure 1: Ecosystem accounting framework (UN, 2017).

4.2 The classification of ecosystem services

The Common International Classification of Ecosystem Services (CICES) has emerged during the drafting work on the SEEA-EEA. For accounting purposes, the CICES distinguished three main types of ecosystem services: provisioning, regulating and cultural services. The CICES emphasized those services that have direct implications to humans (UNSD, 2016)

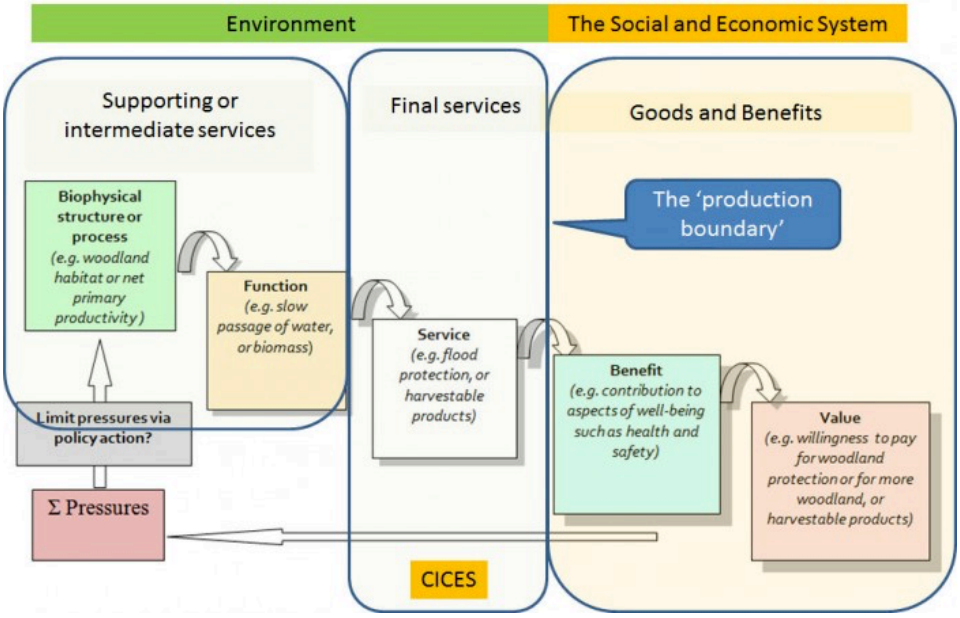

Figure 2: Common international classification of ecosystem services (UN et al., 2014)

4.3 The attempt to develop pastureland SEEA-EEA for the Kyrgyz Republic

Although the development of any ecosystem account requires large human capacity for data collection, analysis and technological resources, the SEEA can provide more focused valuation. (1) It can focus on a single ecosystem asset, ecosystem type, or ecosystem service. (2) It may combine a single ecosystem asset or ecosystem type with multiple ecosystem services to manage specific ecosystems or ecosystem types (e.g., pasturelands, wetlands). (3) It may consider both multiple ecosystem types and single ecosystem services to understand the supply of a specific service across the landscape (e.g., water regulation, carbon sequestration). (4) It provides an account for the areas of the common land for better management (e.g., national parks and protected areas) (UN, 2017). Which approach to use depends on country's potential in data accessibility and quality, technical tools, and policies priorities.

In creating the pastureland SEEA-EEA for the Kyrgyz Republic it is possible to use all these four approaches by using ecosystem extent accounts, ecosystem capacity accounts, ecosystem supply and use accounts in physical and monetary units. The following accounts are relevant to estimate and develop Kyrgyz Republic's pastureland account.

4.4 Ecosystem extent account

One of ecosystem account units that help refine the valuation of the pastureland in the Kyrgyz Republic is the ecosystem extent account. This account focuses on an ecosystem (spatial) asset, which, in this paper, means the extent of pastureland asset within a certain area. The structure and standard of the SEEA-CF principles for asset accounts can be used.

In order to accurately find out about the pastureland extent, however, it is imperative to have accurate maps of the pastureland. In the Kyrgyz Republic, these maps are not available yet. Some available maps include rocky areas and other unproductive areas within the pastureland. Setting boundaries for pasturelands does not have clear standard and definition, causing disputes among key stakeholders, such as agricultural and forestry agencies, industries and local herders (Mestre et al., 2013).

4.5 Ecosystem supply and use account

This paper covers the ecosystem supply and use account by estimating benefits from pastureland ecosystem services. The disservices list will be served as opposite side of ecosystem services balance as a potential negative effect. In order to compile these accounts, the classification of pastureland services in the Kyrgyz Republic was developed. This is a specific list of services typical to the Kyrgyz pastureland.

In this classification, services are divided into two categories: provisioning and regulating/cultural services. Provisioning services produce SNA benefits. This includes food, wool, and fodder. Regulating and cultural services are regarded as non-

SNA, which implies information about extra benefits of particular services. Table 1 represents the proposed methods to estimate the ecosystem services in the Kyrgyz Republic.

For the economic evaluation, the most important ecosystem services that can be evaluated are selected (Markandya et al., 2014). These services often affect human health or livelihoods and should be taken into account when deciding. Here the economic valuation can be possible without monetary assessment.

The data sources for valuation can be found in scientific studies on ecosystems in protected areas, concentrations of plants and animals. And statistical reports of state organizations, including those of local authorities, can provide socio-economic data as well as data on existing market mechanisms (e.g., sales, services and goods, price).

The proposed classification (Table 2) mainly uses three methods of evaluation. (1) The direct method uses the market value of services, the production function of the ecosystem and market prices. (2) When there is no information on market prices and the product is only for subsistence, it is possible to calculate the value of the product as the cost value. For example, the value of irrigation water can be represented as the sum of the costs of supplying water to the field, that is, the costs of maintaining the irrigation system. (3) The method of value transfer can be used almost everywhere, where there is no possibility to conduct research. The method is also used to assess carbon sequestration and a globally important environmental service product (Markandya et al., 2014).

Table 1: Pastureland service classification and valuation methods in the Kyrgyz Republic

<table>
<tr><th>Type of services</th><th>Valuation and data source</th><th>Description</th></tr>
<tr><td colspan="3">Provisioning Services</td></tr>
<tr><td>Product:</td><td rowspan="5">The benefits can be measured by harvested products in physical units multiplied by market price minus production costs.
Data source: Statistical</td><td rowspan="5">The income is the gross value by sector. It is possible to analyze changes in production for 10-20 years, and estimate the loss. The main problem is to analyze changes in other production factors (e.g., fertilizers, machinery) (Markandya et al., 2014).</td></tr>
<tr><td>Meat</td></tr>
<tr><td>Milk</td></tr>
<tr><td>Wool or Skin</td></tr>
<tr><td>Cattle Fodder</td></tr>
<tr><td colspan="3">Regulating Services</td></tr>
</table>

Prevention of erosion	The average cost of erosion control is US$44 per hectare per year (De Groot et al., 2012). Data source: agriculture and forestry department data base.	Difficult to assess without detailed information on pasture locations. Without information about water resources management services, the mean values of other countries can be used.
Water regulation	Water storage capacity in the ecosystem/m^3/per hectare; Difference between rainfall and evapotranspiration in m^3/ha/year (Hein, 2014). Data source: Hydrometeorological data base, scientific studies.	Water regulation includes (i) flood control; (ii) maintaining dry season flows; and (iii) water quality control (e.g., trapping sediments and reducing siltation rates). Temporal, i.e. inter-annual and intra-annual, variations are important here (Hein, 2014).
Carbon sequestration	Ton of carbon (or carbon-dioxide) sequestered a year/hectare/km^2 (Hein, 2014). Data source: Kyrgyz Giprozem, scientific studies.	For a preliminary assessment of carbon stocks, the average value used in other countries can be referenced (benefit transfer method); Climate Change and Terrestrial Carbon Sequestration in Central Asia (2007) provides an approximate value of carbon deposits of 0.5-4.5 tons of carbon per hectare. The estimated cost of the deposits is US$139/ton. The corresponding cost value depends on the discount rate. The rate is at 3%, to give a US$2-18.8/hectare/year (Markandya et al., 2014).
Cultural Services		
Recreation and tourism	Cost of building a yurta (traditional house). Data source: local district budget, land rent data	Possible costs are determined by (potential) visits by local and international visitors.

Cultural and health	A net income from kumyz treatment (drink from horse milk). Data source: local district budget	If there are important holidays related to agriculture (e.g., a harvest festival), then the expenses must be included.

4.6 Ecosystem disservice list

Ecosystem functions also have effects that are harmful to human well-being, and these effects are called ecosystem disservices (EDS) (Döhren et al., 2015). EDS have seldom been considered in the context of broader social ecological challenges (Saunders and Luck, 2016; Shackleton et al., 2016) such as pastureland. The disservice list of the Kyrgyz pastureland was developed in this research. To have a whole picture about the ecosystem we need to include EDS.

Table 2: The disservice list of the Kyrgyz pastureland

Types of disservices	**Valuation and description**
Greenhouse gas emission from livestock	A head of cow releases 70-120 kg of methane/year; The number of livestock multiplied by the emission intensities (emissions per unit of product). The emission intensity from cattle is almost 300 kg CO2-eq per kg of protein produced), meat and milk from small ruminants (165 and 112kg CO2-eq.kg respectively) and cow milk, chicken products and pork (below 100 CO2-eq/kg) (FAO, 2018).
Soil degradation	Prevention of degradation of natural resources as a result of soil erosion, siltation and non-agricultural wastewater is estimated at the expense of the cost of restoration activities and payment for water resources.
Nutrient runoff	Some nutrients run into waters (EPA, 2017).
Loss of wildlife habitat	Natural pasture provides important habitat to a variety of wildlife species.

4.7 Ecosystem capacity account

For ecosystem capacity account in formula belowwas established by Kyrgyz scholar Isakov in 1975. The original purpose of this formula was to estimate the current feed productivity of the pastureland. Although this is not entirely relevant to the SEEA, some elements of this formula allow us to find about ecosystem conditions and services. If the pastureland deteriorates, so does the amount or quality of particular ecosystem services. For instance, feed productivity decreases. This concept is relevant

to the SEEA-EEA as it also connects feed productivity with food products such as meat and wool.

The current feed productivity of the pastureland is determined by the following formula (Isakov, 1975)

$$CCcur = Y*S*0.7 / 7.5 * D \qquad (1)$$

where:
CCcur – current feed productivity of pastures
Y –edible herb yield within a pasture plot
S – pasture area
D – number of days when pasture is used
0.7 – coefficient of pasture use (based on the recommendation of "Kyrgyzgiprozem")
7.5 – the required amount of dry matter per one livestock unit per day, kg

This formula estimates potential natural forage productivity with the replacement of edible herb yield within a pastureland plot to desired yield of edible herbs within a single state in a pastureland plot (Isakov et al., 2015). The difference of the potential nature forage productivity and the current feed productivity of the pastureland inform us about degradation as an element of ecosystem capacity account. Or if we know about degradation condition, it allows us to calculate the potential nature forage productivity by adding degradation to the current feed productivity.

5 Conclusion

In addition to forest accounts, pastureland accounts can be part of the SEEA in the Kyrgyz Republic. This system can provide SNA and non-SNA benefits that can show the importance of natural capital accounting. In general, value may be of less significance for supporting decision-making, but changes in this value would be a relevant pointer for total changes in natural capital.

The proposed set accounts, methods and indicators within the SEEA-EEA for the pastureland of the Kyrgyz Republic show the possibility of developing the EEA even with limited available data sources. It describes pastureland conditions in accounting tables. The estimation of the pastureland value will promote the sustainable utilization of the pastureland and ultimately lead to food security of the Kyrgyz Republic. Today pastureland users pay land tax for the use of each hectare of pastureland, and the proper definition of categories can increase the budget revenue in the future.

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Death of Rural Police Departments Threaten the Security of Their Small Towns

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Abstract
Rural police departments have the same legal and operational obligations as those in urban areas, but far fewer resources due to their smaller tax base. Lack of resources can cause these small departments to be disbanded and the town contracts with the county sheriff's office for law enforcement services, which provide fewer services and longer response times. Based on a case study of a small town police department, this research suggests that small town police chiefs must be politically astute in creating and utilizing a variety of strategies to support and maintain their departments, find supplementary funding sources, and promote a positive, cohesive work environment to encourage job satisfaction and reduce turnover.

Keywords: Rural police departments, rural law enforcement, police management, rural police department funding, preserving rural police departments

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Introduction

Small towns gain safety and security benefits when they have their own police department, but at great expense, so they face many challenges in maintaining their police departments. Even the smallest police departments require a large portion of a rural town's budget. The smaller the town, the lower the tax base, so the less funding is available to provide all town services. The police department competes with all other town departments for funding. If the police department receives a budget increase to buy a new car, for example, there may not be enough money that year to fix potholes or replace burned out street lights.

All police departments in a state are required to meet the same standards, have the same training, and are obligated to have minimum equipment to perform their duties, no matter the department's size. Like metropolitan departments, rural police departments must provide the personal equipment officers need to do their job, such as uniforms, belts, and guns. They must also have an office, patrol cars, evidence collection equipment, and evidence storage facilities, like all other departments. All of this is expensive to maintain.

When a small town decides they can no longer afford their police department, it is disbanded. Once a police department is disbanded, it won't be reinstated, as it is very expensive to create a police department. With no police department, the town will contract with the local county sheriff's office to provide law enforcement services. This is less expensive, but doesn't provide the same level of safety and security. Sheriff's deputies will drive through the town each shift every day, but they probably won't be there when there when an emergency happens as they will be patrolling in the county or tied up with another call for service. No deputy will be assigned full time to the town.

Data collected for an organizational assessment of a rural police department in the State of Virginia, USA, was conducted over a three month period in fall 2016 revealed a great deal about the challenges of maintaining a small town police department. This research provides an understanding of how the subject agency runs its day-to-day operations and its ability to accomplish organizational goals. The subject department has ten full time employees; one chief, one sergeant, two corporals, one investigator, four patrol officers and one office assistant. The population of the town is approximately 2,288 over 1.4 square miles (United States Census Bureau). This research addresses departmental changes that have occurred since 2009, when the current chief was promoted from lieutenant. The organizational assessment of this police department revealed that the police chief has many constraints on his budget, but also is very politically and financially innovative in stretching his budget and finding outside funding to support his department and his officers.

Research Design

Organizational assessment factors applicable to police departments used to analyze the subject rural police department were chosen based on published research (Burnet, 2015; Crank & Langworthy, 1992; Chambers, 2001; Galliher, Donavan, & Adams, 1975; Payne et al., 2005; Robbins & Judge, 2016; Sims, Ruiz, Weaver, & Harvey, 2005). Organizational factors used were: work specialization, departmentalization, chain of command, span of control, centralization/decentralization, organizational size, employee diversity, organizational goals, rate of internal organizational change, rate of external organizational change, organizational structure, organizational culture, employee group cohesiveness, employee training opportunities, employee absentee rate, employee turnover rate, and hiring process formality. Each factor was defined and measured throughout the data collection process to assess the organization according to accepted organizational assessment theory (Robbins & Judge, 2016; Morgan, 2006).

Data Collection

The data for this assessment was collected from the subject police department over approximately three months from police department documents beginning when the current chief was appointed (2009-2016). The information collected was aggregate data found in the policies and procedures on file in the department. No data from interviews of the officers or other employees of the department were included in the data. If information was offered voluntarily by any member of the department, not the result of questioning nor an expression of an opinion, these data were included.

Assessment Factors and Findings

Work specialization

This factor explains the key job tasks of individuals who work within the department that must be completed while on duty each day, if applicable circumstances arise. The department's work specialization was found to be low. All officers handle tasks appropriate to their rank and position within the department, but are crossed trained to accomplish all law enforcement tasks. The exception is the chief, who is crossed trained in all law enforcement tasks, but is the only officer who plans programs, directs all officers, evaluates department operations, develops an annual budget proposal, controls budgeted expenses, attends city council meetings, and serves on committees and boards of agencies related to promoting crime prevention and improving law enforcement, among other duties. The chief fills in on patrol when needed and does backup as necessary. Other officers have numerous job requirements due to the small size of the department, but are still able to effectively execute them. The administrative assistance is more than a secretary. She also does tasks that require her to go to training, which relieves officers from some tasks they would do in a larger department. The chief takes on a number of tasks that in a larger department a subordinate officer would be assigned.

Departmentalization

This department was found to be departmentalized appropriate to the size of the organization (Brunett, 2015). Employees have separate duties assigned, but it is common to find different positions with similar activities. The positions are differentiated by the degree to which job duties are performed and the level of responsibility. Higher ranks have greater responsibilities. Few job functions can be grouped together due to the small number of employees.

Chain of command

This variable reveals the authority and the unity of command that occurs within the police department and assesses whether it is weak or strong. The department does not follow the guidelines for the chain of command as described in the policies and procedures. Based on information volunteered by multiple members of the police department, all officers are encouraged to go straight to the chief for any problematic situations, without following the chain of command, whether he is present in the building or reached by telephone. While the lower ranking officers are aware that they are under the supervision of anyone with a higher rank than their own, the chain of command within the police department is weak, because all the members of the department go to the chief for any questions.

Span of control

Span of control focuses on whether or not the chief can effectively and efficiently supervise the number of employees at the department. The span of control for this department is very narrow. Due to the small size of the department, the chief is able to maintain direct contact with all his officers and make sure all his employees understand their orders and how they are to be executed (Dias and Vaughn, 2006). The chief is able to supervise all nine of his employees, influence each officer on an individual level, and create strong relationships with his employees.

Centralization and decentralization

A department is said to be decentralized when the lowest-level managers are in charge of decision-making processes, as well as, implementation processes (Robbins & Judge, 2016, p. 254). The structure of this department is as equally centralized as it is decentralized. The department is centralized in that the department's policies list and define who is responsible for making executive decisions while on duty. While centralized, the department is decentralized in the implementation of the departmental policies and procedures. There are many occasions when lower ranked officers on the scene of an accident or crime are in charge of making important decisions due to their specialized training in an area that a higher-ranked officer does not have. Sims, et al (2005) found that rural police departments are likely to be more relaxed and, thus, decentralized, as is the subject department.

Organizational size

When measuring organizational size, a department is considered small when there are twenty or fewer full time employees. The organizational size of this department is small since it has less than twenty-employees. There are ten full time employees; one chief, one sergeant, two corporals, one investigator, and four patrol officers and one office assistant. The size has been consistent over the last eight years.

Employee diversity

This study examines surface-level diversity, which is defined as diversity demographics, which include age, gender, race, and years of experience before joining the department (Robin & Judge, 2016). The department is in the middle diversity level, between a low and high diversity rate. The mean age of officers within the department is thirty-four. This department has had a total of sixteen males, one female officer, and one female administrative assistant over course of the past eight years. Fifteen of the sixteen men were white, one male was African American, and the two females were white. Seven employees, including the administrative assistant, had no prior experiences, two employees had between six months to two years' experience, two employees had between three and five years, and seven employees had more than six years of prior experience.

Diversity in this department has been consistent over the past eight years, probably due to the characteristics of the rural area and its distance from a large metropolitan area. The population of this town is predominately white, which is reflected in the number of white employees at the police department. Police applicants from the community typically are older, meaning there is a greater likelihood they have previous police training and years of experience. This is helpful to the department since they cannot afford to send any new employees to the police academy for initial training and is reflected in employees' years of prior experience.

Organizational formality

Formality is the degree to which jobs in an organization are standardized and the policies and procedures that govern the behaviors of employees in each job position (Robbins & Judge, 2016, p. 254). This police department was found to have a high degree of formality, with detailed policies and procedures employees must follow that dictate responsibilities, task duties, and meeting the public's expectations. These polices allow employees to know what is expected of them in legal issues and in times of crisis, and professionally establish what is expected of the employees when an issue or conflict surfaces and details how to deescalate the problem.

Organizational goals

Clear set organizational goals encourage employees to be motivated, productive, and satisfied with their jobs (Jung, 2014). Goals typically focus on the intentions for

operating the organization and its overall philosophy. This department was found to have a very specific set of organizational goals and clear mission statement that all employees are obligated to uphold: serving and protecting the community (Morgan, 2012). The goals of the mission statement are fully embedded in the employees' daily tasks and duties, making the organizational culture strong. The Chief of Police ensures that his employees abide by the norms established within the mission statement.

This police department's mission statement was compared to the mission statements of two rural police departments of similar size (Town of Boone, 2016; Town of Chincoteague, 2016). The subject department's mission statement shared common themes with the other two in holding their officers and employees to a high standard to ensure quality protection of the community and to provide their officers with appropriate resources to effectively do so.

Rate of internal and external organizational change

Two types of change are examined here: internal and external change over the period studied. Internal change occurs within an organization and affects the policies and procedures of the organization, itself. External change occurs within an organization due to forces from outside of the organization (Robbins & Judge, 2016, p. 285).

The rate of internal organizational change has been relatively slow within this department over the eight years studied. Although some departmental policies and procedures have changed over the last eight years, few other changes were made. When the Chief was appointed to that office, he created a list of potential changes that he hoped to implement during his time as chief. None of these changes have been implemented thus far due to lack of interest from employees.

Along with the rate of internal change, the rate of external organizational change was slow within this police department, and policies and procedures have remained constant over many years. Two policies and procedures have changed over the eight years studied due to external forces. One policy was enacted by the Virginia State Legislature to establish guidelines for traffic stops, investigative stopping of vehicles, and road check procedures. The second policy also was implemented by the state in regard to eyewitness identification procedures. Another change caused by an outside organization is the yearly budget for the police department. The Town Council, with assistance from the Chief of Police, votes on and sets an annual budget determined by city funds that can be allocated to the department and what resources the department needs each year.

Organizational structure

The organizational structure of the police department represents the communication process and hierarchy of command that the department follows. Overall, the department's organizational structure is a simple structure. This simple structure gives the department the ability to be fast, flexible, inexpensive to operate, and have clear accountability to supervisors (Robbins & Judge, 2016, p. 255). The official organizational chart shows the

chief is the head of the department and each of his subordinates must report to him through the chain of command. According to the organizational chart, patrol officers report to one of the corporals, corporals report to the sergeant, and the sergeant reports to the chief. Due to the small size of this department and the chief's preference, officers usually report to the chief instead of going through the chain of command.

Organizational culture

Organizational culture is developed over years and is rooted in values shared throughout the organization. These values set the organization apart from other organizations and give the organization a sense of identity (Robbins & Judge, 2016). Low organizational culture means the culture has a negative effect on organizational goals, and a high culture has a positive effect on organizational goals. This department blends high and low organizational cultures. The formal policies outlining employee conduct suggest high organizational culture, but the informal nature of this department suggests a low organizational culture, which does not appear to negatively affect organizational goals. The low organizational culture can be seen when some senior officers have refused to complete training requested by the chief. Within informal departments, it is not uncommon for officers to view each other as co-equals (Falcone, Wells & Weisheit, 2002). Another example of this informal dynamic is the unwillingness of some officers to travel and attend training outside of the local commuting area. There are no negative repercussions if employees elect not to attend trainings. However, the data analysis shows high group cohesiveness, which reflects positively on the department's ability to support and meet their organizational goals.

The chief uses various strategies to promote group cohesiveness and employee satisfaction and stretch his constrained budget. In a department that has not seen pay raises in ten years, the chief is able to supplement his officers' pay a little. The state pays the department mileage to transport mentally ill individuals to treatment facilities, which can be hours away. Instead of adding these funds to the department's budget, the chief gives the money to the officer who transported the mentally ill person. One officer is assigned full time to the regional drug task force, so the state pays this officer's salary and benefits. This officer isn't away on task force business all the time. When she isn't, the officer performs her regular duties in the department, so the department has a free officer. Small things, that larger police departments would never do, help the department's budget. They never buy new police cars, and were thrilled recently when they are able to buy a four year old police car. One of the officers is also a mechanic and services the department's cars and does all but very major repairs.

Communication process

Formal communication channels are established by the organization, while informal communication channels are established by the members and employees of the organization (Robbins & Judge, 2016). This factor was assessed based on the organizational structure of the department and volunteered information about communication processes. This department uses a very informal communication process.

The Chief maintains an open door policy and it is common for officers to approach him directly. The same system is used when the Chief communicates to his subordinates. This communication method flows informally in all directions and through multiple department levels. Robins and Judge (2016) describe this as an all-channels method, which has a high level of speed and member satisfaction, with a moderate level of accuracy. The all channels communication method is most effective when all members are able to contribute freely and no one person take a leadership, which has been demonstrated in the cross training and multiple tasks each officer performs.

Employee group cohesiveness

Low or high level of employee group cohesiveness effects how well an organization is able to achieve its goals over time. The employee group cohesiveness of this department was found to be very high, due to the size of the department and the likelihood of close relationships developing. Department policies and procedures detail expectations of how employees should act and conduct themselves within the department and out in the field. Based on information volunteered by members of the department, there are strong relationships among the employees and a high level of camaraderie. Research shows that smaller departments tend to be more cohesive compared to larger departments (Robbins & Judge, 2016, p. 151). Information voluntarily provided indicates there is a high level of trust within the department, and thus a high level of employee group cohesiveness.

Management feedback to employees

Management feedback to employees is measured as high or low, with low representing little or no formalized performance feedback for employees and high a formal and scheduled management feedback process. In addition, policies regarding disciplinary procedures and internal investigations indicate high or low management feedback formality. There is no formal feedback in this department; all feedback given by the Chief to subordinates is informal in nature and on an irregular basis. There has not been a formal performance evaluation process in place at the department in over fifteen years. The reasoning is that without pay incentives associated with positive evaluations performance evaluations are unnecessary. Formal performance evaluations are limited to disciplinary actions and internal investigations, which are set out in department policies.

Employee training opportunities

All police departments in a state, no matter their size, have the same legal and operational requirements. New officers must complete the police academy as their basic training requirement, which can last as long as six months, depending on the state, six months that the officer is paid but not working in the department. Each department pays for the training academy. Every two years all officers must take continuing education courses paid for by each department. When officers are at the training courses they are not working in their departments and their shifts must be covered by the other officers. Employees can receive training to improve their skill sets as an officer, or be trained to be an instructor to train others (Lee, McNamara, Pitt-Catsouphes, & Lee, 2014, p. 205).

These programs are designed to supplement the basic recruit, refresher, advanced, and specialist training offered in local police academies. This department provides in-service trainings to all employees, including the administrative assistant. The in-service trainings are offered at a local criminal justice training academy. Some officers attend training in other state locations. Training opportunities meet or exceed state requirements.

Employee absentee rate

The department accrued 133 absences from 2009-2016. These numbers account for both full shift and partial shift absences. Twenty-one of these are attributed to major medical procedures or injuries. Partial missed shifts accounted for the highest number at fifty total absences. Employees are allowed up to two hours for wellness visits to family doctors. Officers can switch and trade shifts to cover sick days, or other excusable absences. Although twenty-one of the absences in these data can be explained through surgeries or other noted medical procedures, there was little to indicate that employees were missing days to purposefully avoid work as few of the unexplained days coincided with weekends, or days off. Robbins and Judge (2016) suggest a moderate to weak negative relationship between absenteeism and job satisfaction. These data suggest a moderate to high level of job satisfaction, as employees are not leaving for other employment.

Employee turnover rate

Turnover rates are important in understanding employee job satisfaction, because employee turnover has a stronger relationship to job satisfaction than absenteeism (Robbins & Judge, 2016). Turnover rates were measured by aggregate data from the department based on employee histories. Turnover rates were found to be relatively low. Since 2009, ten officers have left the department either through resignation, termination, or retirement. Of these, two retired, four resigned from law enforcement entirely, three left for a larger agency, but returned a few years later. Since 2009, the department has hired ten officers and four are still with the agency.

Hiring process formality

The police department's hiring process includes the recruitment process, background investigation, writing sample, formal interviews, and other strategies used prior to hiring a new police officer and is rated as highly formal, because every step of the process is carried out as listed in departmental policies and procedures. An extensive background investigation is conducted for all applicants, including the applicant's employment history, neighborhood and personal reference check, criminal incident/ arrest history, and any court records. The most qualified applicants receive a formal interview with the chief and sergeant(s). The hiring process takes two to three months before the interview process begins.

In eight years, the department has not altered the hiring process. The chief seeks to hire candidates who have already completed the academy training, eliminating the need for expensive tests such as polygraphs, psychological examinations, physical tests, and six

months away from the department to attend the police training academy. Thus, he is hires those who have been officers in other departments and resigned or were let go. The chief is very careful when hiring to make sure an individual is a good fit in his department and also not a bad officer who was previously fired for significant reasons. Only one person terminated for cause during the research period.

Conclusion

The Chief of Police in this small, rural southeastern United States agency has accomplished many of his goals during his tenure as department leader and has demonstrated innovation politically and financially in maintaining his department. The department effectively meets the state requirements, as well as, the town's required codes. The town is small and in a rural area so the police department is small. The smallness of the town and its associated small tax base provide the police department with a very restricted budget. However, the constrained budget has not prevented the department from meeting state and town requirements and accomplishing its law enforcement duties and organizational goals.

The chief supervises all employees efficiently and uses effective leadership styles to protect and serve the community. The smallness of the department helps maintain strong group cohesiveness and a resulting low employee turnover. Low turnover reduces strain on the department's budget, because the hiring process and overtime pay to fill in missing shifts is expensive. All police department members wear "many hats" that sometimes overlap, but each officer has certain tasks they must successfully accomplish. This variety encourages employee satisfaction even without pay raises for many years. The chief does provide random small amounts of money to officers who drive mentally ill citizens to treatment centers rather than adding these funds to the department's budget. Thus, we see that for a small town police department to survive, the chief has to be politically astute and innovative is finding external funding and motivating employees. The department's officers must be willing to work for low pay without raises, even cost of living raises, unless they are promoted. Hiring officers who are a good fit for the department, who want to be police officers in a rural small town, who understand the working conditions, go a long way toward reducing turnover and protecting the department's budget. The chief and his officers have demonstrated their commitment to preserving their department and this small town's safety and security.

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The Effects of Culture on Consumers' Response to a Carbon Tax and Container Deposit Scheme: A Sustainable Consumption Study

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Abstract
As the temperature of the planet rises, governments are adopting measures to curb human activities that contribute to global warming. Introducing policies that people would adopt and to achieve the desired outcome is, however, a growing challenge. This situation is not quite unexpected particularly in multicultural societies where people have diverse cultural values and attitudes towards environmental issues and policies. Extant literature has cited the importance of cultural influence on the decisions individuals make. Through vertical socialization, individuals learn the values and behaviours that society expects of them. The current study examines the impact of cultural factors on consumers' response to a carbon tax and cash incentives on consumer preference. Data obtained from an online survey involving 294 respondents in a discrete choice experiment was analysed using an ordered logit approach. The focus of the experiment was on the choice of soft drinks in three pack types namely glass, PET and aluminium cans which have different levels of carbon emission. A comparison of the estimated ordered logit models would show that the effects of a carbon tax and cash incentives on pack type choice do tend to vary according to the consumer's cultural heritage and social identity. The implications of the above findings on policy and possibly industry practice are discussed. Future research directions, particularly in the context of container deposit schemes which are growing in popularity are also explored.

Keywords: Choice Modelling, Cultural Identity, Carbon Tax, Container Deposit

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Introduction

The rising temperature of the planet has led to greater interests in governments to introduce policies to mitigate its adverse effects. Producing more goods to meet demand is causing resources to become scarcer and pollution to rise. Policies to change consumer behavior is now more important than ever to lessen the effects of global warming.

Literature Review and Research Objectives

Utility theory states that consumers will behave in such a way that it will bring them the greatest satisfaction. Disincentives such as taxes and fines make certain behaviors such as littering and choosing carbon intensive products to be costly or undesirable. Incentives on the other hand make buying certain products more desirable such as rebates for solar panels and container deposits to encourage recycling. Policies, intentionally or consequentially, can change the satisfaction that certain behaviors will bring to the consumer.

Standard economic theory assumes that preference is exogenous and invariant. This assumption has been criticised in many studies. According to Van Den Bergh, Ferrer-i-Carbonell, and Munda (2000), there are interactions in an economic system which can affect preferences and hence utility. In an environmental tax regime, consumers may compare their purchasing intentions with friends and family to see if it is worthwhile to switch to less polluting products. From a social norms perspective, what other people do and think matters (Farrow, Grolleau, and Ibanez , 2017) which means that significant others can influence a person's environmental behaviour.

Previous studies have shown that attitudes toward the environment have an influence on sustainable environmental behaviour such as demand for green electricity and reduction of energy consumption (Van den Bergh, 2008). There also are studies that examined the effects of culture which sociologists have identified as the underlying factor that dictates the values and beliefs of consumers about the environment and its protection (Kletzan, 2002). These studies show that aside from economic factors, the effects of psychological, cultural and social factors need to be analysed to gain a better understanding about how people will respond to environmental policies.

Understanding the effects of culture on environmental behaviour is made more important in a multicultural society such as Australia's. In a multicultural society, policies may not achieve its expected results. The wants that policy makers assume consumers to have may not apply across cultural groups. One's culture and the people outside it can influence an individual's values. Their upbringing and exposure to other cultures may have taught them that benefits or outcomes from policies do not always bring the satisfaction they want.

This study therefore aims to examine among others, the influence of culture on an individual's response towards environmental policies. A choice experiment employing a carbon tax and container deposit was conducted. The experiment was designed to help understand how a cross-section of consumers choose the pack type of an everyday product, the soft drink. It is widely known that packaging impacts the environment as the material and process used to produce them involve significant

levels of carbon emission. The three commonly used pack types namely, glass, PET, and aluminium cans with varying levels of carbon tax and container deposit comprise the core elements of the choice sets in the current study. A carbon tax represents a punitive instrument placed on goods and services that emits high levels of carbon during its manufacturing or delivery. The resulting price will be higher, making it costlier. A container deposit rewards consumers when they return a container or packaging for recycling. It is an incentive to encourage ecologically friendly behavior.

Methodology

Data collection

The survey was conducted online and an external agency was employed to recruit the respondents. There were 294 respondents who completed the survey. Adults aged 18 to 40 years living in the Greater Sydney Area formed the sample. This age group consumes the most carbonated drinks.

Although budget constraints prevented recruiting a national sample, there also was another advantage in restricting the sample to Greater Sydney. Greater Sydney has the lowest proportion of adults aged 18 to 40 who are born in Australia, making it more culturally diverse than other capital cities for the said age group (ABS[1], 2016).

Experimental design and choice sets

A full factorial 2x2x3x3 choice experiment was designed for the study. Each respondent was presented with six choice sets, each one with three carbonated drinks to choose from. A drink in a glass bottle, plastic bottle and aluminum can featured in each set. Figure 1 shows an example of a choice set. A carbon tax, container deposit or both were assigned randomly to each drink.

Figure 1 - Example of a choice set shown to a respondent

Attributes tested and scale questions

Table 1 shows the attributes, levels tested in the experiment used in the analysis. A drink received a pack size category, small or large, randomly. Depending on the category, a volume level was picked at random to be shown on the choice sets. Table 3 shows the pack size category and the set of volume levels for each. The codes used for the pack type reflects carbon emissions produced during manufacturing. Table 4 shows the carbon emission levels generated by each pack type, ranked from the lowest to the highest.

The covariates included demographic information and the scale items described in Table 5. These scales show how environmentally aware the respondent is, the behaviour he or she has adopted to help the environment and the belief that such actions can make a difference.

Identity points allocation

The respondents allocated 100 points across different items that define who they are today in the survey. This is adapted from the Golden Bear Omnibus conducted by the University of Berkeley (Abdelal, 2009) with two fundamental differences. In the Omnibus study, respondents had to give points on prescribed items while in the current study, the respondents selected the items themselves. If an item was not relevant, alternative words were presented for their selection. The other difference is the presence of *other* as an item. Respondents who are task sensitive will make choices based on items presented to them. In this case, respondents may assign points because they felt they had to. Including "other" allowed them not to use items that had no meaning for them.

Table 1 - Attributes tested and levels

Attribute	Levels
Carbon Tax (added after the GST[2])	0%
	10%
	25%
Deposit (added after the GST)	$0.00
	$0.10
Size	Small
	Large
Pack type	Glass bottle
	PET (Plastic) bottle
	Aluminium can

Table 2 - Attributes tested and levels

Pack size category	Volume levels (ml)
Small	250, 300, 330, 375, 385, 390
Large	440, 450, 600

Table 3 - Carbon emission produced for one tonne packaging type manufactured from raw material. Source: DECCW[3], 2010)

RANK	Pack type	Manufactured Weight	Carbon Emitted
1	Glass	1 Tonne	0.59 Tonnes
2	Polyethylene Terephthalate (PET)	1 Tonne	2.56 Tonnes
3	Aluminium	1 Tonne	16.4 Tonnes

Table 4 - Scales used in the questionnaire

Scale	Description
Ecologically Conscious Consumer Behaviour (Straughan & Roberts, 1999)	Only 11 items were retained to reduce the questionnaire's length. The respondents were asked how regularly they performed certain ecological behaviours, from Never (0) to Always (100).
New Environmental Paradigm (Dunlap, 2008: Dunlap, Van Liere, Mertig, and Jones, 2000)	Only 10 items were retained from this scale. The respondents were asked if they Strongly Disagree (0) or Strongly Agree (100) with each statement describing the current state of the environment.
Perceived Consumer Effectiveness (Straughan & Roberts, 1999)	Only 3 items were retained for relevance. The respondents were asked if they Strongly Agree or Disagree with each statement on the environmental impact that an individual's action can bring.

Transformed variables

Below are the newly created variables used in estimating the models.

1. Deposit (%) **-** The amount of the container deposit was expressed as the share of the price shown to the respondent.

2. Tax ($) - The dollar amount of the carbon tax rate was calculated by multiplying it by the price with the sales tax or GST (shelf price) before the container deposit was added.

3. Newrate - This variable represents the additional amount added to the shelf price relative to the sales tax (GST). It was computed by taking the difference between the sales tax and the combined dollar amount of the carbon tax and container deposit divided by the sales tax. The advantage of this variable is that even if no instrument was applied to a drink, it will still register a value.

4. Eccb10 - This variable is a measure of how often the respondent demonstrated an ecologically friendly behaviour. It was adapted from Straughan and Roberts' (1999) average score for ecologically conscious behaviour.

5. Relative ranking of attributes – The relative importance of an attribute compared to the other attributes identified by the respondent as important in choosing the pack type of a soft drink.

6. Recoded income and age variables -To be consistent with symmetrical coding required for discrete choice experiments, it was decided to ensure that demographic variables were also coded symmetrically. The income categories were retained from the 2011 Census (ABS, 2011) with exception of combining "Negative Income" and "No Income" as one category. The eleven categories were coded symmetrically where -5 was given to the lowest and +5 to the highest income level. The calculated age of the respondents based on their year of birth was also symmetrically coded. Those aged 18 received a code of -11 and those who were 40 received a code of +11.

Data Analysis & Results

The analysis was undertaken using an ordered logistic probability approach using the software, NLOGIT[4]. A general model was first estimated for the entire sample followed by one model for each of the six regions representing the ancestry of the respondents. For those whose ancestries were from more than one region, the respondents were included in more than one model. The model for each region retained only the significant variables from the general model.
The estimated models for respondents with ancestries from Africa, Asia, Europe and the Middle East initially showed that ECCB10 was significant. A regression was performed for each region using items to which they were asked to allocate points. The results presented in these estimates were the forecasted scores (ECCB10R) from these regressions.

Cultural composition of the sample

Table 5 shows the ancestries of the respondents. As it is possible for a respondent to have ancestries from more than one region, the figures in Table 5 do not add up to 100%.

Table 5 - Ancestries of respondents

Sample size, n = 294	
Region	**Proportion of sample**
Africa	3.74%
The Americas	8.50%
Asia	44.22%
Europe	48.98%
The Middle East	4.76%
Oceania	20.41%

Results for entire sample

The results for the entire sample are shown in Table 6. All the variables were significant at 1% or 5% except for Newrate. The combination of a carbon tax and deposit was not significant. The major findings are discussed below:

1. The carbon tax in itself is not a punitive instrument

A respondent is less likely to choose a drink with a carbon tax as shown by the negative coefficient of the carbon tax [Tax(Coded)]. Importance placed on the tax could partially account for this result as shown by the coefficient's size for [Tax(Coded) × RankTax].

Environmentally friendly behavior complements the importance placed on the carbon tax. The coefficient [RankTax × ECCB10] shows that environmentally friendly respondents, to whom the carbon tax is important will not buy a drink that had one. Respondents who have higher incomes are more willing to pay a higher carbon tax for their drink. The coefficient for the interaction term between the dollar amount of tax and income [Tax($) × Income] was positive. Those with higher incomes might continue to buy carbon intensive products because they can afford the carbon tax.

2. The container deposit can work as a reward

The container deposit did make a drink more attractive. The coefficient for the coded deposit was positive. Respondents were more likely to choose a drink with a container deposit if it was important to them. The coefficient for the interaction between importance and the deposit's share of price was larger [Deposit(%) × RankDeposit].

Environmental awareness and the importance placed on the container deposit had opposite effects. The coefficient for the interaction term between importance and the NEP score was negative [Newrate × ECCB10]. An environmentally-aware respondent will choose a drink that has a container deposit even if it was not important to him/her.

The belief that one's actions can help the environment did complement the container deposit. The interaction term between container deposit and the PCE score was positive [Deposit(%) × PCE]. A respondent who believes on their actions and places importance on the deposit will choose a drink that has one.

3. Other variables affect combinations of the carbon tax and container deposit

The combined effects of the carbon tax and container deposit was only significant when other variables were included. The coefficient for the interaction term between Newrate and coded size was negative and statistically significant [Size × Newrate]. Respondents are less likely to choose larger sized drinks with a container deposit and higher carbon tax rates. Consumers are not willing to pay more for volume if a deposit and a higher tax rate are involved.

The combined effects did not complement environmentally friendly behavior. The interaction term between the Newrate and ECCB was negative [Newrate × ECCB10]. A respondent who observes environmentally friendly behavior is less likely to choose a drink with a higher carbon tax and a container deposit. The coefficient also suggests that combining tax and deposit is a useful deterrent for consumers who do not care about the environment. Respondents who have lower ECCB10 scores will not choose

a drink with higher carbon tax and deposit. They will choose a drink with either a lower carbon tax, container deposit or both.

Classes of respondents

Based on the estimated models for individual regions, three respondent groups which showed similar significant variables within each group were identified.

Group 1: Attribute sensitive respondents
This group consists of consumers who chose their drinks based on product attributes only.

Table 6 – Results of the Ordered Logistic Regression for the entire sample

	Entire Sample
Volume (ml)	0.00671*** (0.00046)
Tax(Coded)[5]	-0.53565** (0.25324)
Price with sales tax (GST)	-1.14286*** (0.05528)
Deposit (Coded)[6]	0.19395*** (0.06029)
Newrate[7]	0.14624 (0.20760)
Newrate × ECCB10	-0.07294*** (0.02202)
Size[8] × Newrate	-0.08638*** (0.02730)
Size × Age(Coded)[9]	-0.01497*** (0.00504)
Tax(Coded) × RankTax[10]	-0.34302*** (0.05494)
RankTax × ECCB10	-0.02165*** (0.00871)
Tax($)[11] × Income (Coded)[12]	0.05172*** (0.02237)
Deposit(%)[13] × RankDeposit[10]	10.5970*** (2.77327)
RankDeposit × NEP	-0.03492*** (0.01129)
Deposit(%) × PCE	1.71880*** (0.51216)
Price × RankPrice[10]	-0.02912*** (0.00969)
Threshold – Mu(1)	0.03441*** (0.01771)
Threshold – Mu(2)	1.62938*** (0.04294)

Log-likelihood	-4885.42288
Restricted Log-likelihood	-5369.63782
Chi-Square	968.42989
Degrees of Freedom	14
McFadden Pseudo R^2	0.0901765
No. of Observations (N)	5749
Variables (K)	17
Information Criteria AIC	9804.80000
AIC/N	1.70500
*** P-value <= 0.01; ** P-value > 0.01 & <= 0.05, * P-value > 0.05 & <= 0.10	

Group 2: Ecological responsive respondents
The results for this group show that environmental behavior (ECCB10R) either complemented or worked in opposite directions with the product attributes.
Group 3: Multi-attribute responsive respondents
The estimated ordered logit model for this group showed that almost all of the variables that were significant for the entire sample were also significant for this group. Some of the product attributes and their environmental attitudes played a part in their choices.

Results for Attribute sensitive respondents

Table 7 shows the results for respondents with ancestries from The Americas and Oceania. The results for Oceania are the only ones shown in this paper as it had a bigger sample. The raw data showed that the container deposit was significant for both regions. To improve the model for The Americas, the container deposit's share of the shown price was used. The coefficients of the container deposit are not comparable with Oceania. Below are the significant results.

Table 7 - Results for Attribute Responsive Consumers

	Americas[14]	Oceania
Volume (ml)	0.00314** (0.00141)	0.00619*** (0.00091)
Tax(Coded)		-0.91559*** (0.14361)
Price with GST	-0.62358*** (0.17200)	-1.03627*** (0.11665)
Deposit - (Coded) or Deposit (%)	10.7436* (5.98349)	0.11028* (0.06518)
Newrate	-0.39286*** (0.09596)	
Size × Newrate	-0.20522** (0.09523)	-0.11680** (0.05783)
Tax(Coded) × RankTax		-0.43228*** (0.14456)
Tax($) × Income		0.10535** (0.05106)
Threshold – Mu(1)	0.47514*** (0.06968)	0.35077*** (0.03902)

Threshold – Mu(2)	1.48817*** (0.13667)	1.60502*** (0.09368)
Log-likelihood	-432.72025	-1018.52235
Restricted Log-likelihood	-455.55470	-1097.12523
Chi-Square, Degrees of Freedom	45.66889, 4	157.20576, 6
McFadden Pseudo R^2	0.0501245	0.0716444
No. of Observations (N) & Variables (K)	N = 465, K=7	N = 1174, K = 9
Information Criteria AIC, AIC/N	879.40, 1.891	2055.0, 1.75
*** P-value <= 0.01; ** P-value > 0.01 & <= 0.05, * P-value > 0.05 & <= 0.10		

1. Respondents with ancestries from Americas considered attributes together
The results for The Americas showed that respondents did not consider the combined carbon tax and deposit by itself. The variable Newrate by itself was significant for The Americas while it was not for Oceania. This variable was only significant for respondents with Oceanian ancestries with the drink's size [Size × Newrate].

2. Tax was important for respondents with ancestries from Oceania
Respondents with Oceanian ancestries were less likely to buy a drink if the carbon tax rate was high and it was important to them [Tax(Coded) × RankTax]. They may place more importance to the carbon tax than for The Americas. The coded carbon tax rate by itself was not significant for The Americas while it was significant for Oceania.

3. Those with higher incomes are willing to pay the carbon tax for Oceania
The dollar amount of the carbon tax and income was significant for respondents with Oceanian ancestries [Tax($) × Income]. This was not significant for The Americas. Respondents with Oceanian ancestries may be willing to buy carbon intensive products as they can afford to pay the carbon tax.

Results for Ecologically Responsive Consumers

Table 8 shows the results for these respondents. Respondents with ancestries from Africa, Europe and The Middle East showed ECCB10R scores were significant. Results for Europe were only shown in the conference as it had more respondents and because of time constraints. Below are the significant results.

1. Importance of product attributes was not significant for Africa
Current environmental behavior and the belief they can make a difference motivated respondents with African ancestries. Environmentally friendly consumers will choose drinks that have a high carbon tax and a container deposit [Newrate × ECCB10R]. Respondents who believes they can make a difference to the environment will buy a drink with a deposit even this had a small share of the price [Deposit(%) × PCE].

2. The deposit was more important for those with Middle Eastern ancestries
Environmentally friendly consumers are less likely to buy drinks with high carbon taxes with a container deposit. Scale variables did not influence importance placed on the carbon tax and container deposit. The carbon tax was not significant by itself.

3. The carbon tax was more important for those with European ancestries

Those with European ancestries showed the more environmentally friendly they are, the more likely they will put importance on the carbon tax [RankTax × ECCB10R]. This does not mean that they are willing to pay more tax. They are not willing to pay for drinks with higher carbon taxes. These seemingly conflicting results show that these respondents are attentive to the carbon tax.

4. Respondents with European ancestries considered the pack size of the drink

Respondents who had European ancestries paid attention to the drink's size [Size × Age(Coded)]. Younger respondents are more likely to choose a drink that is larger. Older respondents are more likely to choose smaller sized drinks.

Table 8 - Results for Ecologically Responsive Consumers

	Africa	**Europe**	**Middle East**
Volume (ml)	0.00533** (0.00226)	0.00923*** (0.00065)	
Tax(Coded)		-.87668*** (0.08511)	
Price with GST	-0.91752*** (0.28088)	-1.47286*** (0.08351)	-0.18903*** (0.03902)
Deposit - (Coded)		8.00425*** (2.40691)	0.63202*** (0.18114)
Newrate × ECCB10R[14]	-0.11216** (0.05000)		-0.06217** (0.02640)
Size × Newrate		-0.07376* (0.03845)	
Size × Age(Coded)		-0.02171*** (0.00681)	
Tax(Coded) × RankTax		-0.46932*** (0.08735)	-0.32385* (0.17173)
RankTax × ECCB10R		0.00139** (0.00069)	
Tax($) × Income	0.25068** (0.11879)		
Deposit(%) × RankDeposit			0.57050*** (0.20263)
Deposit(%) × PCE	2.67719* (1.38400)		
Threshold – Mu(1)	0.38366*** (0.09696)	0.25916*** (0.02255)	0.65120*** (0.11024)
Threshold – Mu(2)	1.93445*** (0.25336)	1.69755*** (0.06327)	1.65184*** (0.19670)
Log-likelihood	-180.2606	-2266.68436	-240.62391
Restricted Log-likelihood	-193.43729	-2546.41191	-252.24505
Chi-Square, Degrees of Freedom	26.35337, 4	559.45509, 7	23.242270, 4
McFadden Pseudo R^2	0.0681186	0.1098516	0.0460708
Observations (N), Variables (K)	N=201, K=7	N=2743, K=10	N=252, K=7
Information Criteria AIC, AIC/N	374.50, 1.863	4553.40, 1.66	495.20, 1.965
*** P-value <= 0.01; ** P-value > 0.01 & <= 0.05, * P-value > 0.05 & <= 0.10			

Results for Multi-Attribute Responsive Consumers

Respondents with Asian ancestry considered more attributes and different attitudes and current behavior influenced their choice. The presentation mentioned a few because of time constraints. Table 9 shows the results for these respondents.

1. The belief in making a difference influenced their response to the deposit
Respondents with Asian ancestry show that those who believed that their actions helps the environment will buy drinks with a deposit [Deposit(%) × PCE]. The more important the container deposit, the more likely they will choose a drink that had one even if its share of the price was small [Deposit(%) × RankDeposit]. The deposit by itself was significant.

Table 9 - Results for Multi-Attribute sensitive consumers

	Asia
Volume (ml)	0.00449** (0.00064)
Price with GST	-0.85100*** (0.07877)
Deposit - (Coded)	17.0595** (6.8694)
Newrate	-0.62747*** (0.05268)
Size × Newrate	-0.08440** (0.04030)
Size × Age(Coded)	-0.01486* (0.00779)
Tax(Coded) × RankTax	-0.41144*** (0.07313)
RankTax × ECCB	0.00127** (0.00063)
Tax($) × Income	0.06795** (0.03242)
Deposit(%) × RankDeposit	9.34677*** (3.17750)
Deposit(%) × PCE	2.05285** (1.01141)
Price × RankPrice	-0.03472** (0.01425)
Threshold – Mu(1)	0.43069*** (0.02949)
Threshold – Mu(2)	1.60144*** (0.00063)
Log-likelihood	-2231.01154
Restricted Log-likelihood	-2431.23248
Chi-Square, Degrees of Freedom	400.44187, 11
McFadden Pseudo R^2	0.0823537
No. of Observations (N) & Variables (K)	N = 2605, K = 14

Information Criteria AIC, AIC/N	4490.000, 1.724
*** P-value <= 0.01; ** P-value > 0.01 & <= 0.05, * P-value > 0.05 & <= 0.10	

2. Respondents with Asian ancestry placed importance on more attribute
Compared with others, respondents with Asian ancestries placed importance on price, carbon tax and deposit. The large proportion of respondents with Asian ancestries in the sample and the diverse cultures in this region may have contributed to this result.

3. The carbon tax is not significant by itself
Respondents to whom the carbon tax is important are less likely to buy drinks that had one [Tax(Coded) × RankTax]. Respondents with Asian ancestry are attentive towards the carbon tax. Those who are more environmentally friendly also saw the tax as important [RankTax × ECCB]. Those with higher incomes are willing to pay the carbon tax [Tax($) × Income]. They may continue to buy carbon intensive products if they can afford to pay the carbon tax.

4. The combined effects of the carbon tax and container deposit was significant
Respondents with Asian ancestry were less likely to purchase a drink with a high carbon tax and deposit.

Accuracy of the ordered logistic models

Table 10 shows the accuracy of all the models. This table shows the models correctly classified 67% to 70% of the drinks as chosen or not chosen by the respondents. The models were not good at predicting which drinks the respondents will buy. The models did not classify any drinks in glass bottles correctly. The models predicted less than 6% of drinks in PET (plastic) and less than 11% in cans as chosen or not chosen.

Table 10 - Accuracy of the different Ordered Logistic models

	Overall	**Glass Bottle**	**Plastic Bottle**	**Aluminium Can**
Entire Sample	69.53%	0.00%	0.46%	10.18%
Africa	67.66%	0.00%	0.06%	0.00%
The Americas	67.74%	0.00%	0.00%	0.00%
Asia	70.21%	0.00%	0.00%	10.40%
Europe	68.47%	0.00%	5.93%	9.22%
Middle East	67.06%	0.00%	0.00%	4.17%
Oceania	69.51%	0.00%	0.00%	0.03%

Differences on ecological behavior

Table 11 shows the significant variables for the regression of ECCB10. Respondents with ancestries from Africa, Asia, Europe, and the Middle East. This was a common variable for their models. The predicted values, ECCB10R was used in the ordered logit model.

The table shows environmental awareness (NEP) and beliefs in their own actions (PCE) were significant for all respondents except those with Middle Eastern ancestries. Marital status, sexual orientation and points given to people of the same

heritage show people immediately close to them are influential. These variables were significant for respondents with African and European ancestry. The table shows that people who may not be immediately close to them also influenced respondents with Middle Eastern ancestries.

Conclusion

Culture influences how individuals decide. Their values and people around them can influence their environmental behavior. Priorities differed across cultural groups as shown by the differences in the product attributes used. The models cannot correctly predict the drink a respondent will choose although it was good at predicting what they wouldn't choose.

Table 11 - Results of the regression for ECCB10

Points[16] given to:	**Africa**	**Asia**	**Europe**	**Middle East**
•Marital Status	-1.34895*** (0.04822)			
•Sexual Orientation			0.03505*** (0.00390)	
• People of Same Heritage			-0.11812*** (0.00510)	-4.65764*** (0.03448)
• People of Different Heritage				0.01601*** (0.00466)
Years Lived[17] × Points given to living in Australia				-0.00595** (0.00262)
Residuals of NEP[18]	-0.00100 (0.028787)	1.97386*** (0.01233)	2.20125*** (0.01312)	0.00025 (0.01475)
Residual of PCE[18]	-0.49260 (0.03148)	1.97070*** (0.01162)	2.12347*** (0.01208)	-0.00546 (0.01653)
No. of Observations	3993	47190	52272	5082
F-Statistic	261.65	15064.12	8123.72	4854.24
(df1,df2)	(3, 3990)	(2, 47188)	(4, 52268)	(5, 5077)
R^2	0.1644	0.3897	0.3834	0.8270
Adjusted R2	0.1638	0.3896	0.3833	0.8268
Root MSE	4.7500	4.2761	4.3464	2.1223
*** P-value <= 0.01; ** P-value > 0.01 & <= 0.05, * P-value > 0.05 & <= 0.10				

Future research would benefit from the following:

1. Use responses reflecting the decision-making process as primary variables
Literature in discrete choice experiments states analysts need to use answers about their decision-making if none of the attributes were statistically significant (Hensher, 2005). In this study, ranks or importance placed on the carbon tax, container deposit and price should not be the main variables. The results showed that this should not be the case. Different cultures will have different values. Individuals from different cultures will have different priorities.

2. Increase representation of different cultures

The sample represented respondents with Asian and European ancestries well. This was not the case for those with ancestries from represented in the sample. This was not the case for respondents with African and Middle Eastern countries.

3. Change the orientation of the models

The estimated models were aimed at predicting which drinks the respondents are likely to choose. However, they were better at predicting the drinks that will **not be chosen,** regardless of their pack type. Future researchers should gear their models at predicting the likelihood of rejecting a drink. This will be helpful for policy analyst to determine which attributes need to be changed to discourage consumers from buying carbon intensive products.

Footnotes

1. Australian Bureau of Statsistics (www.abs.gov.au)
2. The sales tax in Australia is called the GST (Goods and Services Tax). It is currently at 10%. To obtain the dollar amount, the shelf price is divided by 11.
3. Department of Environment, Climate Change and Water NSW (http://www.environment.nsw.gov.au)
4. NLOGIT is a statistical software used for but not limited to Discrete Choice Modelling (www.limdep.com/products/nlogit/)
5. The carbon tax rate was coded as follows: -1(0%), 0(10%), +1(25%)
6. The container deposit was coded as follows: -1($0.00), +1($0.10)
7. The Newrate is meant to capture the combined effects of the carbon tax and container deposit. The variable was calculated as below. The symbol $ indicates that the actual dollar amount was used
8. $$Newrate = \frac{(Carbon\ Tax(\$) + Container\ Deposit\ (\$)) - (Sales\ Tax\ or\ GST(\$))}{(Sales\ Tax\ or\ GST\ (\$))}$$
9. The drink's size was coded as follows: -1(Small), +1(Large)
10. The age was recoded as discussed in the Methodology. Those aged 18 were coded as -11 and those aged 40 coded as +11. The codes for the other ages was obtained by adding 1 to the code of the previous age.
11. The relative rank of an attribute can be estimated as below where A is the number of attributes used and S is the rank given where 1 is the most important attribute to the respondent.
$$RelativeRank = 1 - \left\lceil (S-1) \times \frac{1}{A} \right\rceil$$
12. The dollar amount of the carbon tax was calculated as below where the shelf price is the price where only the sales tax (GST) was present.
$$Tax(\$) = Carbon\ Tax\ Rate\ (\%) \times Price\ with\ sales\ tax\ or\ GST\ (\$)$$
13. The income categories used was recoded. The lowest income category received a code of -5 and the highest +5. The code of the other categories were obtained by adding 1 to the code of the income level lower than itself.
14. The deposit was expressed as the share of the price shown to the respondent.
15. Instead of using the coded value of the container deposit for Americas, its share of the price shown was used.
16. The forecasted values of ECCB10 was used to produce ECCB10R. The regression models used is shown on Table 11.
17. The variables listed are the points that the respondent gave to that item when they were asked to allocate points across items that best describe who they are today.
18. This is the number of years the respondent has lived in Australia. If they were born in the country, their age was used.
19. The scale variable NEP was highly correlated with ECCB. It could be used as an independent in a regression. A separate regression for the NEP was estimated retaining statistically significant variables. The residuals were then used instead of the NEP score to forecast the values ECCB10R. The same applied to the PCE scale variable.

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Environmental Intensity of Human Wellbeing in Bhutan: Evidence from Regression Analysis

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Abstract
A special volume on 'Absolute Reductions' in the Journal of Cleaner Production (Akenji, Bengtsson, Bleischwitz, Tukker, & Schandl, 2016) emphasised the need for a radical socio-technical transformation that can bring material, energy and emissions within the ecological limits. Economic activities are at the heart of consumption of materials and energy and emissions being the waste generated. With regard to the nexus between economic development and environmental impacts, the Environmental Kuznets Curve (EKC) hypothesis is widely used, some studies supporting it while others contrasting it. Now there is an emerging research strands that test EKC by investigating the nexus between the environmental intensity of human wellbeing (EIWB) and economic growth (Knight & Rosa, 2011; Lamb, 2016; Lamb et al., 2014; Steinberger & Roberts, 2010; Sulkowski & White, 2015). This study follows this emerging research strand. Using a regression analysis, the paper attempts to discipline conjecture with data for the case of Bhutan, which hardly appears in the relevant literature. Based on the results of the regression analysis and the EKC theory, the paper discusses if the case of Bhutan inclines towards the treadmill of production theory or the modernisation theory.

Keywords: Bhutan, wellbeing, environment, regression analysis

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Introduction

The need for a radical socio-technical transformation that can bring material, energy and emissions within the ecological limits was emphasised in a special volume on 'Absolute Reductions' in the Journal of Cleaner Production (Akenji et al., 2016). Suggesting to consider sustainable development seriously. Sustainable Development requires living within the ecological limits that implies respecting the natural system and not to transgress the planetary boundary (Rockström et al., 2009). Maintaining symboitic relation with nature and balancing material and non-material components of human wellbeing are the key features of Gross National Happiness (GNH), the development paradigm pursued by Bhutan. Furthermore, Bhutan has pledged to remain carbon neutral till perpituity. Not surprisingly, net zero carbon emission is now being seen as the ultimate pathway to hold the global temperature rise below 1.5°C (Rogelj, Luderer, et al., 2015; Rogelj, Schaeffer, et al., 2015).

The goals of Bhutan are complex and challenging - requiring the integration of socio-economic and environmental dimensions which is at the heart of Bhutan's GNH development philosophy that is increasingly associated to Sustainable Development (Allison, 2012; Brooks, 2013; Frame, 2005). However, until now no empirical studies exist for Bhutan on the nexus between economic growth, human wellbeing and environmental pollution vis a vis ecological stress, despite Bhutan wanting to remain carbon neutral as well as to be a middle income country by 2020 within its overarching GNH development philosophy. Thus this paper attempts to fill this gap by using the concept of environmental intensity of human wellbeing (EIWB) (Dietz, Rosa, & York, 2009, 2012; Knight & Rosa, 2011) to discipline conjectures with data. A report on the ecological footprint of Bhutan mentions about the possibility of research area on linking subjective wellbeing and ecological footprint (GNHC, 2014).

The rest of the paper comprises of four sections. A brief literature review is provided in the immediate section below followed by the regression analysis. Thereafter the results and discussions are elaborated with reference to the existing literature surrounding the complex relation between human wellbeing, economic growth and environmental quality. The findings of this research provides an answer to the question on whether Bhutan's development pathway follows the treadmill of production theory or the modernisation theory.

Environment and economic growth

The nexus between economic growth and environmental quality are often explained using the Environmental Kuznets Curve (EKC) hypothesis starting with the works of Grossman and Krueger (1995). The term EKC was first coined by Panayotou in 1993 (Kijima, Nishide, & Ohyama, 2010). In the era of Sustainable development goals (SDG) and climate change, GHG emission is a key environmental issue, which is perhaps the greatest environmental issues being faced by humanity in the 21st century. Encouragingly, the decoupling between economic growth and fossil fuels (the main source of greenhouse gases) is happening around the globe (Newman, 2017).

The relevance of the EKC theory were analysed using regression analysis on time series and cross-sectional data. For instance, Song, Zheng, and Tong (2008) used an Ordinary Least Square estimation for a cubic log-log model to assess EKC in the

provinces of China for three environmental degradation such as waste water, solid waste and waste gas. They found EKC for all the three environmental degradation. Pérez-Suárez and López-Menéndez (2015) used polynomial terms of GDP per capita as the independent variable to conduct regression analysis for 108 countries (including Bhutan[1]) to examine the EKC puzzle and found different patterns of EKC, while Bhutan along with other 10 countries showed 'other cubic pattern' of EKC. Al-mulali, Weng-Wai, Sheau-Ting, and Mohammed (2015) used a fixed effect and random effect model to conduct multi-variant regression to examine EKC in 93 countries and showed that the EKC holds for high incomes countries but not for low income countries. Other studies have demonstrated six different relationships besides the inverted U-shaped curve between economic growth and environmental pollution (Yang, Sun, Wang, & Li, 2015), suggesting no consensus on the validity of the EKC theory. Additionally it is also pointed out that there are numerous empirical studies but very few theoretical studies on the EKC (Kijima et al., 2010). Furthermore, it is increasingly acknowledged that there is no single model that fits every country or region, given that every country has different underlying factors that drive the correlation between human development and environmental stress.

Those research highlighted above applied EKC to investigate the relationship between environmental quality and economic growth, with no variables that address social goals or wellbeing. Now there is an emerging research strands that incorporated variable(s) capturing human wellbeing besides the variables on economic growth and environmental quality. These are discussed in the following section.

Environment, economic growth and wellbeing

Applying a regression analysis for a cross-sectional data for 107 countries, Jorgenson (2014) finds that economic development leads to increase in carbon intensity of human wellbeing (CIWB). Similarly, using a regression analysis and a stochastic frontier production model for a cross sectional data for 135 countries, Dietz et al. (2009) showed that increasing environmental impact does not necessarily lead to greater human wellbeing and that the effect of affluence on human wellbeing characterises a diminishing return. Studies also found positive relation between income and carbon emissions measured by both consumption-based approach and territorial approach (Lamb et al., 2014) contrasting EKC hypothesis. A research at province level in China that investigated the effect of economic growth and technological changes on CIWB found that economic growth has a positive effect, while technological innovation has non-linear and negative effect on CIWB (Feng & Yuan, 2016). Vemuri and Costanza (2006) showed that natural capital has a significant and positive impact on life satisfaction making them to propose a National Wellbeing index which adds natural capital variable on the existing Human Development Index. Similarly, using a cross-national data on GDP per capita, subjective wellbeing index and ecological footprint for 105 countries, Knight and Rosa (2011) supported the treadmill of production theory but not the modernisation theory. There are other studies which demonstrated that energy and carbon emissions required for human development is decreasing over time (Steinberger & Roberts, 2010), suggesting that enhancing human wellbeing need not be in lockstep with resource depletion and environmental stress.

[1] This was the only reference the author came across that mentions about Bhutan.

Methodology

In line with the existing literature, a multivariate regression technique is used to investigate the relationship between human wellbeing, environmental impact and economic growth, arguably capturing the three dimensions of Sustainability. The regression analysis is conducted using EViews, a sophisticated data analysis and forecasting tool developed with emphasis on time series analysis (IHS, 2014). To capture the environmental intensity of human wellbeing (EFWB) in Bhutan, the ratio variable between ecological footprint per capita (EFpc) and life expectancy (LE) was used along with GDP per capita (GDPpc) representing economic growth. The details on the choice of these variables are discussed.

The choice of variables

The type of variables used for evaluating the environmental efficiency (or intensity) of human wellbeing vary depending on the data availability and scope of the study. For instance some studies has used CO_2 emission per capita as representing the environmental impact (Feng & Yuan, 2016; Lamb et al., 2014) (Jorgenson, 2014), others have used ecological footprint per capita (Dietz et al., 2009; Knight & Rosa, 2011). Similarly for human wellbeing, life expectancy was used as a proxy variable in some studies (Dietz et al., 2009, 2012), while others have used life satisfaction index (Knight & Rosa, 2011). The choice of variables for this study were limited by the availability of long time series data. Life expectancy and GDP per capita[2] were obtained from the data bank of the World Bank, while the ecological footprint per capita were obtained from the Global Footprint Network (GFN, 2016)[3]. A longer life expectancy represents healthy living which ultimately boils down to physical fitness and good food – perhaps all of us wants to live longer even for a day. Similarly the ecological footprint measures the wholesome consumption level environmental stress exerted by a person onto the natural system. While GPD per capita as a measure of economic growth is well known.

The regression model

In formulating an econometric functional form, inspiration is drawn from David Hendry's four golden rules, namely: 1) think brilliantly, 2) be infinitely creative, 3) be outstandingly lucky and 4) otherwise stick to being a theorist. To explore the relationship between ecological intensity of human wellbeing and economic growth in Bhutan and following the 1st and 2nd golden rules of David Hendry, this study explored the functional form specified in equation (1).

$$EFWB = C + \beta_1 lnGDPpc + \beta_2 (lnGDPpc)^2 + \beta_3 (lnGDPpc)^3 + \beta_4 lnPOP + \varepsilon_t \quad (1)$$

Where, EFWB is the ratio variable between EFPC and LE. C is the intercept. lnGDPpc is the per capita GDP in natural logarithmic form and the polynomial terms of GDPpc are centred by subtracting the mean of lnGDPpc to reduce collinearity (Knight & Rosa, 2011; York, Rosa, & Dietz, 2003). The linear and polynomial terms of GDPpc are being widely used in the EKC literature (Song et al., 2008; Yang et al.,

[2] The per capita GDP were available from 1980 onwards only
[3] The ecological footprint were made available upto 2012 only as per the data access provided by GNF.

2015). POP is the population and ε is the error term that captures those unobserved explanatory variables. Finally β_1 to β_4 are the coefficients of the corresponding explanatory variables that are of primary interest in this study, which are to be estimated by regressing equation (1) using EViews.

The above equation attempts to include everything within the available data that is necessary for modeling, but nothing more in line to the Occam's principle (Yang et al., 2015) to avoid under-specification as well as over-specification (Wooldridge, 2016). On regressing equation (1), it was found that the linear and the cubic terms of the GDPpc were statistically insignificant letting us to choose the reduce form model shown by equation (2).

$$EIWB = C + \beta_1(\ln GDPpc)^2 + \beta_2 \ln POP + \varepsilon_t \quad (2)$$

The functional form in equation (2) was treated to comply with Gauss-Markov assumptions for time series regression (Wooldridge, 2016). For instance, tests for the presence of serial correlation and heteroskedasticity were conducted using the Breusch-Godfrey (BG) LM test and Breusch-Pagan-Godfrey (BPG) test respectively (IHS, 2014; Wooldridge, 2016). Fortunately in this study we were outstandingly lucky (David Hendry's 3rd golden rule) – the p values fail to reject the null hypothesis of no serial correlation and homokedasticity. These tests results also suggest that the functional form was specified quite well for the available variables. Furthermore, to avoid spurious regression arising from trending variables, equation (2) was regressed with time trend and the EViews output shows insignificant p value. No collinearity between the independent variables were observed as confirmed by the variation inflation factors which were within the acceptable range of 10 (Dietz et al., 2009; IHS, 2014; Knight & Rosa, 2011). The robustness of equation (2) was also checked through robust least squares method and Autoregressive Conditional Heteroskedasticity (ARCH) method showing no significant differences for the values of the estimated parameters and their associated standard errors.

Results and Discussions

Equation (2) was estimated using the Ordinary Least Squares (OLS) estimation method in EViews and the estimated equation is provided in equation (3) with standard errors in parenthesis.

$$EFWB = \underset{}{13.51097} + \underset{(0.020551)}{0.230104}*(\log GDPpc)^2 - \underset{(0.031331)}{0.873187}*\log(pop) \quad (3)$$

Adjusted R^2 is 0.965284; standard error of regression is 0.030427.

The plot of the estimated equation shows a U-shaped curve as shown in Figure. 1. The estimated equation illustrates that the relation between the EFWB and GDPpc are positive and non-linear and that with population is negative, demonstrating that the findings of this study are partly surprising and the discussions are elaborated in the following subsections.

Discussion on the non-surprising result

The non-surprising part can be referred directly from figure. 1 and the coefficient of the quadratic GDPpc term shown in the estimated equation (3). They show that the stress induced on the ecology for enhancing human wellbeing follows a significantly positive and curvilinear relationship with economic growth. The plot clearly shows a turning point beyond which increase in GDP per capita further intensifies the environmental intensity of human wellbeing, which clearly resonates with the central tenet of the GNH thinking, which seeks to balance ecology, economy and human wellbeing. In other words, after certain threshold growth in per capita GDP increases the ecological stress, clearly contradicting the modernisation theory but supporting the treadmill of production theory aligning with the findings for cross-sectional data (Dietz et al., 2012; Knight & Rosa, 2011). In this study we call it as the 'WE Kuznets curve' that illustrates the relationship between Wellbeing and the Environment vis a vis ecology – respecting the EKC literature and the recent surge in wellbeing research and in particular the happiness kuznets curve proposed by (Sulkowski & White, 2015). The GNH philosophy does not reject GDP, but side-lines GDP as the sole measure of human wellbeing and not surprisingly increasing number of research are showing that there is a threshold value beyond which increasing GDP does not commensurately leverage human wellbeing, thus characterising a diminishing returns.

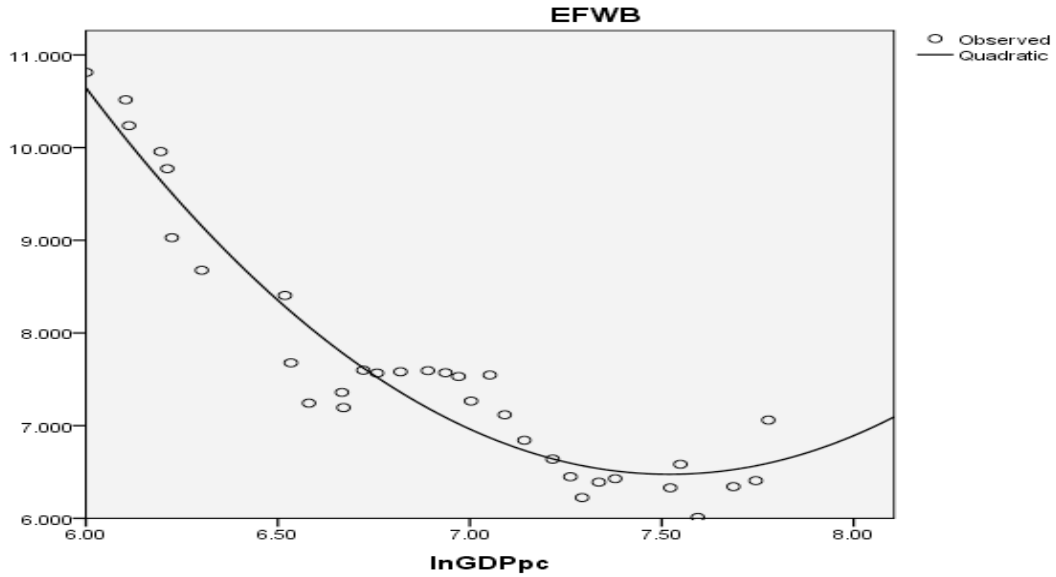

Figure 1: EFWB versus per capita GDP

The turning point shown in Figure.1 is around US$ 2100 (in between estimates), which is slightly lower than that of US$ 2558 found for cross sectional data (Dietz et al., 2012). In a separate research, (Kubiszewski et al., 2013) found that genuine progress indicator does not increase beyond GDP/capita of US$ 7000. In Bhutan, the mean monthly per capita household expenditure in the richest quintile is Nu. 17802, while that in the lowest quintile is Nu. 2468 (RGoB & World Bank, 2017). Now comparing these values to the threshold value in figure. 1, the household expenses of the richest quintile are higher by a factor of 1.6 (assuming US$ 1 equals Nu. 63), whereas the lowest quintile are 4.5 times lower. This finding complements the need for absolute reduction in material (Akenji et al., 2016) by those in the richest quintile for the case here. This indicates that while the poorest could reduce their ecological

stress by increasing their income, it is time for the richest to control their relentless expenditure to reduce their ecological footprint. This seemingly paradoxical effect of income on ecological footprint is well explained by the curvilinear relationship shown in figure. 1 – calling for convergence of per capita income to uphold a sustainable and happy society.

Discussion on the surprising result

The first surprising part of the finding is that the graph in Figure. 1 shows an early bend. This earlier bend raises a question - If the prevailing socio-cultural norms adheres itself to the sufficiency concept embedded in the GNH philosophy that attempts to balance material and non-material components of human wellbeing? The earlier bend in case of Bhutan could be explained perhaps by the fact that the majority of the Bhutanese people are dependent on subsistence farming and the natural resources, which has a minimal contribution to the stacking of GDP, while fulfilling the basic needs.

The next surprising part of the finding is that the coefficient of the population is negative, which in statistical terms means negative effect, that is, the growth in population will reduce the ecological intensity of human wellbeing in Bhutan. Is it possible or plausible? This finding may seem spurious to those who hold onto the theory of human ecology, which argues that population is the main driver of ecological and environmental degradation. Also population is one of the main factor in the IPAT and STIRPAT formulation. Furthermore, the finding contradicts the environmental impact of population growth highlighted in the national strategy of Bhutan (NEC, 1998). However, this part of the finding seems to align with the findings of (Toth & Szigeti, 2016) who claimed that it was over-consumption not over-population that is causing overshoot of the Earth. Lamb et al. (2014) also found negative coefficient of population growth on both the territorial-based and the consumption-based per capita carbon emissions. It is argued that such finding may be plausible in Bhutan as well since household size[4] tend to decrease as the per capita income increases - that is, a fewer people in a house, the corollary being size of house (i.e the physical living space) per capita increases, which follows the lines of reasoning posed by Lamb et al. (2014). The household size in Bhutan decreased from 5.3 to 3.2 as we moved from the lowest quintile to the highest quintile (RGoB & World Bank, 2017). Furthermore, it is likely to see strong correlation between the consumption-based carbon emissions and the ecological footprint, which is a consumption based indicator. The other plausible reason could be due to the low population density leading to a higher per capita ecological footprint in Bhutan (GNHC, 2014). Rural Bhutan accounts for 66% of the total population and 64% of total households in 2016 (BLSS, 2017). The average per capita ecological footprint of a rural Bhutanese is 1.86 bha[5], which is higher than that for the urban Bhutanese at 1.74 bha (GNHC, 2014). But urbanisation in Bhutan is striding at a rapid pace and it is expected to reach 77% by 2040 (ADB, 2011). The high per capita ecological footprint could also be attributed to the lower bio-productivity in land-use for production of good and services in Bhutan.

[4] Household size means the number of people living in one house; whereas size of house means the physical area of the housing structure.
[5] bha – Bhutan hectare, which is the global hectare (gha) modified to Bhutan's context.

The caveats of this study

This study have some inherent limitations attributable to statistical inferences from the available data sets as vividly commented by (Toth & Szigeti, 2016), 'expecting precise result from a rough data set is a statistical illusion'. Furthermore, the choice of different proxy variables may show a different result. However the availability of data needs to be considered. Our study used 33 years of time series data, while a longer time series data could have a better statistical inferences, especially in reducing the variances. These limitations are widely known in the literature (Pérez-Suárez & López-Menéndez, 2015).

Conclusion

Using established econometrics techniques, this study has attempted to interlink the relationships among the trilemma challenges of Bhutan - integrating wellbeing (i.e GNH), economic growth (i.e. GDP) and ecological footprint (i.e. environmental concerns). This paper contributed to disciplining the conjectures of normative understanding around the trilemma issues in Bhutan through vigorous analysis of the time series data on some of the key variables.

Using Bhutan as a case study, this research contributed to the highly debated issue on the tri-junctures of economic development, human wellbeing and environmental/ecological impact. Within the validity of the time series data, the case study of Bhutan supports the treadmill of production theory against the modernisation theory. To some extent this research can be considered as a formal attempt to place the case of Bhutan into the burgeoning literature on analysing the environmental impact of enhancing human wellbeing in the framework of Environmental Kuznets Curve theory. The U-shaped and curvilinear graphical plot observed in this research also complements the core goal of the GNH development paradigm that seeks for a balanced development. Suggesting the likely convergence between the GNH paradigm and the treadmill of production theory – at least on the concern of environmental degradation front that is caused by economic growth at any cost.

While this study is first of its kind for Bhutan, it shows a promising line of research that may further inquire into the socio-technical structure of the Bhutanese economy.

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Estimating Effectiveness and Efficiency of Solar Energy Policy for Indonesia: A Hybrid Agent-Based Model Analysis

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Abstract
Our study analyses four solar energy policies and their impacts on photovoltaic (PV) market potential, government expenditure, economic growth, and environment. The analysis uses a hybrid energy agent-based model dedicated to capturing the specific economic and institutional features of developing economies, particularly in Indonesia. We undertake an integrated approach to ABM by combining input-output analysis, life-cycle analysis, socio-economic data, and urban-rural analysis to obtain a comprehensive assessment. The result is a recommendation to abolishing PV grant policy in rural electrification programs. As a substitute, first, the government should encourage PV industry to improve production efficiency and provide after sales service. Second, the government then should arrange financing scheme for the PV investment. Both policies will create PV market in 2050 for 65.1% and 67.6% respectively of rural households without electricity. Capital and interest subsidies cannot further increase PV market potential in rural area. In contrast, our study found policies of previous feed-in tariff and existing tariff cannot diffuse PV in urban households without additional capital and interest subsidies. Indeed, the net metering scheme is recommended as the most effective policy to develop PV market in urban area.

Keywords: energy model, developing country, renewables policy, impact assessments

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1 Introduction

Most developing countries, like Indonesia, still lack of energy access and thus, renewable energy is commonly used to improve rural electrification (Sovacool, 2013). However, renewable energy development is challenged by various barriers, e.g. technical reliability, economic feasibility, and social acceptance (Blum, Wakeling, & Schmidt, 2013; Byrnes, Brown, Foster, & Wagner, 2013; Jacobson & Delucchi, 2011; Nepal, 2012). On account of this, Sovacool (2013) emphasises the importance of appropriate policies in determining the implementation level of renewables-based rural electrifications. Indonesia uses two types of renewables policy for rural electrification (i.e. donor gift policy and independent power producer (IPP) scheme) as alternatives of grid extension by the Stated-owned Electricity Company (PLN). The donor policy has been widely criticised for misunderstanding people needs and poor coordination between institutions (Sovacool, 2013). As a consequence, recently in 2016 the government allows IPP to directly sell electricity to households having no electricity access from PLN. The IPP could use renewable energy technology and then claim a subsidy from the government.

Indonesia used the feed-in tariff (FIT) policy to encourage renewable energy investments by IPP in on-grid electricity system. However, the policy can no longer be implemented due to rejections from PLN which monopolises the electricity market. The FIT was argued to increase the electricity subsidy since the electricity price is already lower than PLN's production cost. In earlier 2017, the FIT is finally replaced by the policy setting of PLN's regional production costs as the maximum reference tariffs to buy renewables-based electricity from IPP. The purposes of the policy are to reduce the PLN's generation costs in the long-term and at the same time, to force IPP to improve their production efficiency.

In this light, our study assesses the effectiveness and the efficiency of those policies by using a hybrid energy model, called Agent-based Renewables model for Indonesia Sustainable Energy (ARISE). Energy model is a standard analytical tool in policy-making to evaluate the costs and benefits of a proposed energy policy. However, most energy models are designed for advanced economies as characterized by commercial energy uses, high industrial energy demand share, dominating formal activity, reliable energy supply, lower income inequality, and liberal energy markets (Al Irsyad, Halog, Nepal, & Koesrindartoto, 2017; Bhatia, 1987; Bhattacharyya & Timilsina, 2010a; Pandey, 2002; Shukla, 1995; Urban, Benders, & Moll, 2007; Van Ruijven et al., 2008). Using such energy models for analysis in developing economies requires significant adjustments namely by considering rural – urban area, traditional – modern energy uses, and heterogeneity of society's characteristics. ARISE is designed to consider those unique characteristics and, most importantly to our knowledge, ARISE is the first energy model integrating the four perspectives (i.e. engineering, macroeconomic, environment and socio-economic perspectives). Nevertheless, we admit that our ARISE is still limited to photovoltaic policy.

The structure of the rest of the article is as in the following. Section 2 discusses energy model in general and the need to integrate social and economic perspectives. Section 3 describes methodology and data, while Section 4 and 5 present the results and policy implication respectively. Section 6 is the conclusion.

2 Literature Review

An energy model in general can be viewed in engineering and economic approaches (Bhattacharyya & Timilsina, 2010b; Connolly, Lund, Mathiesen, & Leahy, 2010; Jebaraj & Iniyan, 2006; Nakata, Silva, & Rodionov, 2011; Suganthi & Samuel, 2012). Engineering approach, also called the bottom-up approach, has the characteristics of a comprehensive database of technologies, energy potential, and costs. However, the bottom-up approach has weaknesses; one of them is a lack of macroeconomic analysis (Li, Trutnevyte, & Strachan, 2015). On the other hand, economic approach, or the top-down approach, emphasizes the interaction of economic sectors in the market. This feature allows assessing the impact of the proposed policy to macroeconomic indicators, such as economic growth, employment and energy prices. Unfortunately, the top-down approach generally has less specifications of energy sector that eventually leads to bias (de Koning et al., 2015). Therefore, integrating both approaches is a common practice to solve the weaknesses of each.

The application of agent-based modelling (ABM) for energy system is evolving because its features could surpass the limitations of conventional energy models. ABM could integrate engineering and economic approaches to social analysis in energy system (Ventosa, Baıllo, Ramos, & Rivier, 2005; Veselka et al., 2002). Initially, ABM is used to assess strategic management of utility companies in liberal electricity market (Sensuß, Genoese, Ragwitz, & Möst, 2007; Weidlich & Veit, 2008), but now ABM is also widely used for analysis in developing countries. For example, Tang (2013b) assesses the impact of clean development mechanism (CDM) on wind energy investment decisions in China, India, and Brazil. Smajgl and Bohensky (2013) analyse the impact of fuel price changes to poverty and deforestation in Indonesia. Recently, Alfaro, Miller, Johnson, and Riolo (2017) develop BABSTER (Bottom-up Agent-Based Strategy Test-kit for Electricity with Renewables) model to compare the impact of five strategies of renewable energy development in Liberia.

However, none of previous studies on renewable energy analyses the perspectives of engineering, macroeconomic, social, and environment simultaneously. Alfaro et al. (2017) discuss engineering and macroeconomic perspectives but exclude environmental and social issues. Meanwhile, Tang (2013b) does not consider the macroeconomic relationship. Integrating these four perspectives could provide comprehensive solutions for multi-interest research in developing countries (Al Irsyad et al., 2017). Therefore, ARISE includes these four issues for analysing potential photovoltaic (PV) markets in Indonesia.

In the macroeconomic perspective, input-output (IO) analysis has been widely used to assess the impact of clean energy supply impact. Markaki, Belegri-Roboli, Michaelides, Mirasgedis, and Lalas (2013) evaluate the impact of targets of renewable energy and energy conservation to economic outputs and employments in Greece. Tourkolias and Mirasgedis (2011) and Simas and Pacca (2014) assess employment growth by viewing renewable energy development in Greece and wind energy projects in Brazil respectively. Chun et al. (2014) estimate economic impact of hydrogen energy development in South Korea for the period 2020 – 2040.

In the social perspective, non-monetary factors have a significant influence to renewable energy investment. Tang (2013a) notices the importance of investors' experiences; an experienced investor is assumed to have higher discount rate for the investment. Graziano and Gillingham (2015) examine the significances of several factors, e.g. neighbour distance, rented house share, household income, race, age, political views, and unemployment rate, to 3,833 PV adopters in Connecticut State during 2005 - 2013. Similarly, by using 2,738 PV adopters in Austin City, Robinson and Rai (2015) confirm the significant influences of location, home value and tree cover to the investment decisions.

In the environmental perspective, providing greener electricity supply is one of the motives of renewable energy development; on the contrary, renewable energy has higher upfront environmental impact (Hertwich et al., 2015). Life-cycle analysis (LCA) has become a powerful analytical tool to compare the total environmental impact of power plant technologies during their lifetime. LCA also has been commonly combined with other approaches to advance system modelling framework (Earles & Halog, 2011; Halog & Manik, 2011).

3. Methodology and Data

The main feature of ARISE is to assess a policy from technical, economic, environmental and social perspectives. Figure 1 shows the interaction of those four perspectives. At the initial stage, ARISE calculates the investment cost and monthly instalment of PV 100 Wp (for off-grid) and 1,500 Wp (for on-grid) based on technical data (e.g. capital cost, operational and maintenance cost) and policy scenario. If the monthly cost is lower than the willingness threshold, a household would invest in the PV. ARISE then uses the number and the monetary values of PV investments to estimate the environmental and macroeconomic impact. The detailed descriptions of each perspective are discussed in the following sub sections.

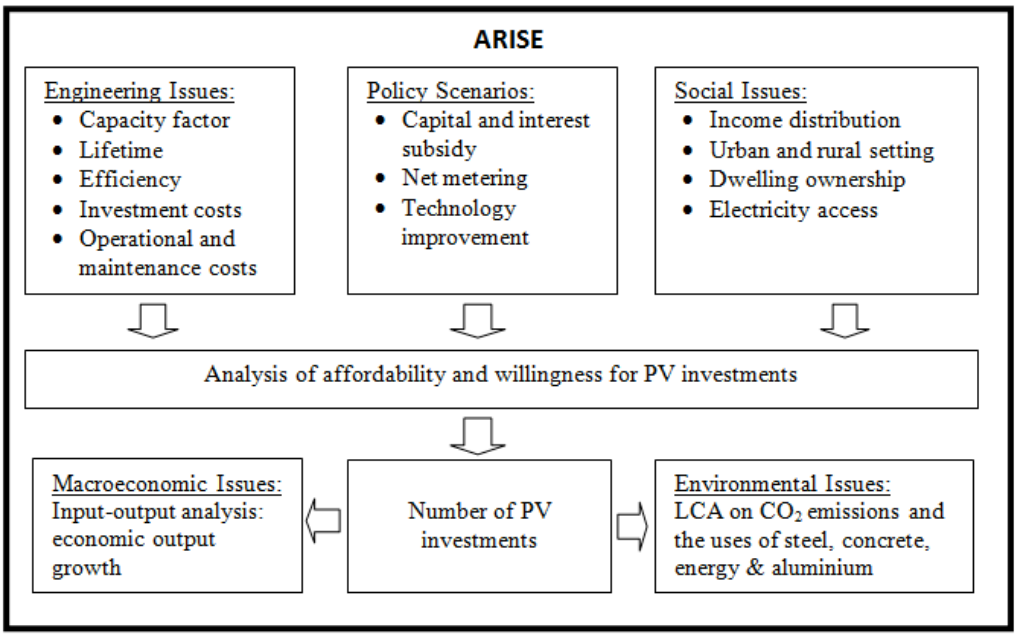

Figure 1: The linkage of four perspectives in ARISE

3.1 Engineering Perspective: Electricity System in Indonesia and Policy Scenarios

Current tariff for renewable energy must refer to PLN's regional generation costs. In regions where the generation cost is higher than the average national generation costs, PLN could buy IPP's PV-based electricity at maximum 85% PLN's regional costs. Meanwhile, the maximum tariff for other regions equals to the regional generation costs. Current solar energy market in on-grid system is limited by a quota in each region. However, to assess full potential of PV market in urban households, our study assumes no quota and a household could sell their PV-based electricity to PLN.

Indonesian government also implements two regulations of renewable energy for rural electrification. First, the government decides giving renewable energy equipment for free (MEMR, 2012, 2017a) and the second one is allowing integrated IPPs (MEMR, 2016c). The first regulation for PV technology started since 1995 and has widely been criticised especially due to the inability of villagers to maintain the PV (Sovacool, 2013). Second, the government encourages IPPs to invest renewable energy in areas without electricity access by giving subsidy to the IPPs (MEMR, 2016c). The subsidy amount constitutes of the difference between IPP's generation costs and the lowest PLN's electricity tariff but is limited to 84 kWh per household per month

Our study compares the effectiveness and the efficiency of four PV policy scenarios. Table 1 shows assumptions on each scenario with descriptions as follows.

a. Scenario 1: Previous renewable energy policy
   Previous FITs (MEMR, 2015a, 2015b, 2016a, 2016b), which were higher than provincial PLN's electricity generation costs, are used. On the other hand, the government supplies free PV equipment to rural households without electricity. Consequently, PV market in rural area remains undeveloped and thus PV after sales service is unavailable. The annual OM cost becomes zero, causing PV lifetime to become 2 years. In this scenario, the government is assumed to have unlimited budget to give free PV each year for all rural households without electricity access.

b. Scenario 2: Existing renewable energy policy
   Current maximum tariff in MEMR (2017b) is simulated. The purpose of the new tariff is to push efficiency in PV manufacturers and, therefore, we assume that the costs and prices are reduced. Moreover, the government is assumed to stop giving free PV unit, yet encouraging PV retailer sales in rural area. However, the contribution of banking sector is still absent in financing PV investment in rural area, meaning zero loan period.

c. Scenario 3: Obligation for banks to finance renewable energy projects
   Scenario 2 is modified that government mandates financial sectors to provide micro-finance for PV investment in rural area. The financing period is five year with interest rate of 12% per annum and maximum loan of 70% total costs. The government then provides 30% capital subsidy and 5% interest subsidy. The new reference tariff in MEMR (2017b) grows due to increasing fossil fuel which

still dominates fuel mix of power plant. The cost growth is assumed to be 9.25%/ year, which was average retail electricity price growth rate in 2010 - 2015.

d. Scenario 4: Net metering scheme
This scenario replaces the maximum tariff with net metering scheme, allowing urban households to export their PV-based electricity to PLN's electricity grid. Export tariff is equal to PLN highest electricity price, which is for 6,600 VA customers. Therefore, the price, which is also assumed to grow 9.25%/ year, is used as a threshold of PV investments by urban households.

Table 1: Assumptions used in the simulation

Parameters	Scenario 1	Scenario 2	Scenario 3	Scenario 4
PV capacity unit (Wp)	100 (rural) 1,500 (urban)	100 (rural) 1,500 (urban)	100 (rural) 1,500 (urban)	100 (rural) 1,500 (urban)
PV lifetime (years)	2 (rural) 20 (urban)	20	20	20
Inverter life time (years)	10	10	10	10
Capacity factor (%/year)	16	16	16	16
PV price (USD/ Wp)	1.91	1.15	1.15	1.15
Inverter price (USD)	1,000	615.38	615.38	615.38
Annual OM costs (¢USD/ Wp)	0 (rural) 2.96 (urban)	0.12 (rural) 2.96 (urban)	0.12 (rural) 2.96 (urban)	0.12 (rural) 2.96 (urban)
Cost of equity (%/ year)	15	15	15	15
Value added tax (%)	10	10	10	10
Inflation (%/year)	5.1	5.1	5.1	5.1
Escalation (%/year)	1.0	1.0	1.0	1.0
Loan period (years)	0 (rural) 5 (urban)	0 (rural) 5 (urban)	5	5
Equity ratio (%)	0 (rural) 30 (urban)	30	30	30
Loan interest (%/years)	12	12	12	12
Debt reserves (% of yearly loan instalment)	100	100	100	100
Interest rate on debt reserves (%)	1.3	1.3	1.3	1.3
Incentives	Feed in tariff	New tariff	New tariff	Net metering
Capital subsidy (%)	100 (rural) 0 (urban)	0	30	0
Interest subsidy (%)	0	0	5	0

* Exchange rate is assumed at IDR 13,000 / USD.

3.2 Social Perspective: Heterogeneity of Willingness for PV Investments

Based on the literature review, heterogeneity in ARISE represents different households' incomes, which determine households' ability for renewable energy investment. Moreover, households in each province are also distinguished by urban - rural regions, electricity access types, and home ownerships. PLN's customers in urban area are assumed to invest in PV only if it has economic benefits, while rural households without electricity access will invest in PV if it is affordable. Home

ownership status also determines the investment decision since rented houses will not likely have renewable energy installation (Graziano & Gillingham, 2015).

The Central Bureau of Statistics (BPS) provides data of socio-economic aspect through annual National Socio Economic Survey (Susenas). To match the 2010 I-O table, our analysis uses Susenas 2010, involving 293,715 households as the sample from the total 61,387,200 households (BPS, 2010, 2017). Data collected in Susenas includes income distributions, home ownership status, and electricity access type of households in rural and urban areas in each province. The number of households and their income are growing based on trend in Susenas 2010 – 2011 (BPS, 2010, 2011).

3.3 Macroeconomic Perspective: Input-Output (IO) Analysis

I-O analysis, developed by Wassily Leontief (1936), uses interindustry transaction table which shows the flow of output produced by industry *i* to industry *j* as an input and to final demand. The latest Indonesia's IO table consists of economic transactions in 2010 for 185 sectors and was published by BPS (2015). Energy sector in the I-O table 2010 is represented by coal and lignite (sector 37), oil (sector 38), gas and geothermal (sector 39), and electricity (sector 145) sectors. Electricity sector is then disaggregated into specific following power plant types (and its abbreviation):

- Coal-based power plant (PLTU)
- Combined cycled gas turbine power plant (PLTGU)
- Open cycled gas turbine power plant (PLTG)
- Geothermal power plant (PLTP)
- Hydro power plant (PLTA)
- Small and Micro-hydro power plant (PLTM/H)
- Wind turbine power plant (PLTB)
- City waste to energy power plant (PLTSa)
- Biomass-based power plant (PLTBio)
- Solar power plant (PLTS)
- Oil-based power plant (PLTD)

We adopt a disaggregation method by McDougall (2002) who used a reference IO table to disaggregate another I-O table. MEMR, Agency of Fiscal Policy (BKF) and Central Bureau of Statistics (BPS) collaborated to modify the updating I-O table 2008 (BPS, 2009) by extending energy sectors to more detailed sectors (Wargadalam, 2014). The modified 2008 table is then used as a reference to extend electricity sector in the I-O table 2010. As a consequence, we assume that economic structure of electricity sector does not change during 2008 – 2010 and, indeed, we also hold this assumption for analysis until 2050. Sectors beyond electricity are aggregated into two sectors, i.e. services and industry sectors, for simplicity reasons. The final IO table is then converted into Leontief inverse matrix, which is included in ARISE.

3.4 Environmental Perspective: Life Cycle Analysis (LCA)

LCA could estimate all environmental impact from the spare part manufacturing process until electricity production process (Noori, Kucukvar, & Tatari, 2015);

however, ARISE focus is only to estimate direct environmental impact in power plants' construction and operation. The impact is estimated by multiplying electricity production and new power plant capacity by environmental impact factors in Table 2.

Table 2: Environmental impact factors of PV

Construction (per MW capacity)					Emission in operating (kg CO_{2e}/ MWh)
CO_{2eq} (kg)	Steel (ton)	Aluminium (ton)	Concrete (ton)	Energy (GJ)	
4,039,116.9	103.5	4.0	50.0	491.6	148.0

Source: Tahara, Kojima, and Inaba (1997)

3.5 Structures in ARISE

ARISE is developed in Netlogo 5.3.1 programming software and has an interface as shown in Figure 2. ARISE operates through three steps, i.e. data load, policy scenario setting and simulation process. First, ARISE will open all data needed, i.e. initial values for variables and parameters, Leontief inverse matrix, and regional database in Geographic Information System (GIS) files. ARISE uses the number of households and their income distributions in GIS files to create agents of households. Each household agent contains properties of province, urban-rural area, electricity supply type, dwelling ownership, income, and PV ownership. Second, users define the values for policy scenarios by using sliders or default button. The third step is the simulation process which in sequence estimates PV investments costs, investment decisions, policy impact, and growth of income and households. The analysis outputs are displayed in a thematic map, two graphs showing environmental impact and subsidy expenditure, and several output boxes showing I-O analysis result and cost calculation results. In addition, ARISE will store numeric data of several important indicators to three spread sheet files.

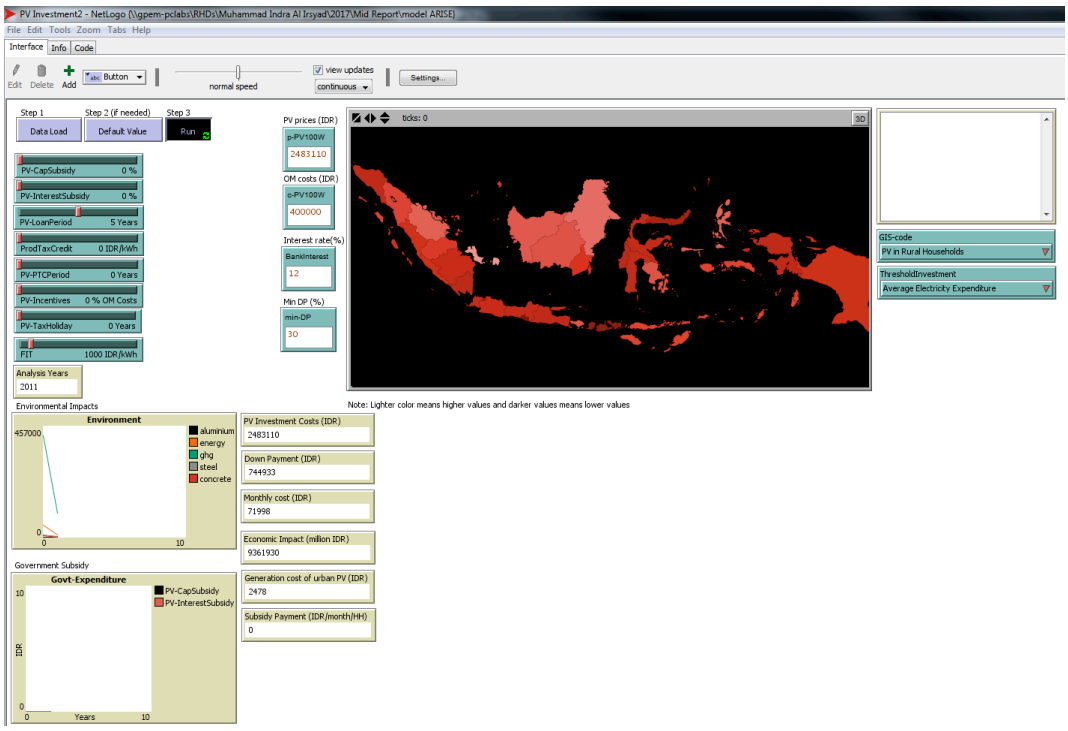

Figure 2: Interface of ARISE

Households with and without electricity access have different purposes for PV investment. For their basic electricity supply, households without electricity access buy a 100 W PV if the PV price or PV monthly cost is lower than the selected threshold (i.e. average electricity expenditure or 30% household expenditure). On the other hand, households with electricity access invest in PV if the revenue requirement exceeds the PV monthly cost. Before simulations, the structure of ARISE is validated by comparing ARISE results with manual calculation using a spreadsheet software. The validation employs various inputs to check the ARISE's outputs on number of households, PV investment costs, number of PV investments, economic impact, and environmental impact. ARISE, its full descriptions and the validation results are available at the OpenABM website[1] and ARISE website[2].

4 Results

We summarise the results of each scenario in Table 3. In Scenario 1, the policy of PV technology grant incurs very high cost. Giving PV 100 Wp for rural households without electricity access will stimulate new economic output for USD 1.6 billion in 2010 but cost the government for USD 559.5 million. Supplying PV to the rural households until 2050 potentially increases the cost by 22 times and leads to severe environment impact, that are 29 million ton CO_{2e}, 26 million kg aluminium, 676 million kg steel, 326 million kg concrete and 3 million giga joule (GJ). Scenario 1 also shows that previous FIT is not attractive for PV investments by urban households.

Table 3: The effectiveness and efficiency of PV policy scenarios in 2050

Policy Scenario	Effectiveness* (MWp)		Efficiency* (per Wp)					
	Rural	Urban	Subsidy+ (USD)	CO_{2eq} (kg)	Aluminium (gr)	Energy (kJ)	Steel (gr)	Concrete (gr)
1	327	0.00	38.15	89	80	9,815	2,067	998
2	234	0.00	0.00	17	9	1,145	241	116
3	227	1,394	0.94	15	8	1,023	215	104
4	228	32,040	0.00	11	7	821	173	83

*Effectiveness and efficiency are measured based on operating PV capacity. + Subsidy only covers capital and interest subsidies.

In Scenario 2, the new tariff also cannot attract urban households to invest in PV. Meanwhile, reductions on PV price and maintenance cost only create PV market in rural area for 227 MWp in 2050. On average, 65.1% of rural households without electricity access could afford PV investments without government assistance. The main markets will be West Kalimantan, East Nusa Tenggara and Papua provinces, whose total market potentially exceeds 1.1 million households. Scenario 2 generates economic output around USD 344.5 million in 2010 and accumulated to USD 4.5 billion in 2050. However, it should be noted that the results are valid by assuming no rural grid expansion by PLN.

[1] https://www.openabm.org/

[2] https://industrialece.wixsite.com/main/single-post/2017/12/31/Agent-based-Renewables-model-for-Indonesia-Sustainable-Energy-ARISE

The policy of financing scheme with partial capital and interest subsidy in Scenario 3 cannot significantly increase PV adopters in rural area. On average in 2050, only 67.5% of rural households without electricity access could afford USD 24.2 equity cost and USD 1.1 monthly payment for 5 years. However, in 2010 analysis, the number of rural PV adopters in Scenario 3 is 10.4% lower while costs for government is 79.9% lower compared to PV grant scheme in Scenario 1. Another advantage is the emergence of urban PV market, reaching 1,394 MWp in 2050. The main markets are East Nusa Tenggara and West Nusa Tenggara provinces for rural and urban PV demands successively. Consequently, total subsidy is rising from USD 112 million in 2010 to USD 1,524 million in 2050. The total economic output will be USD 954 million in 2010 into USD 21,265 million in 2050.

The financing scheme without subsidy in Scenario 4 can maintain the size of rural PV market in 2050 for 2.3 million households, or equivalent to 67.6% of rural households without electricity access. Scenario 4 has larger rural market than the market in Scenario 3 because rural households in Scenario 4 have higher income randomly determined by ARISE. It means that the higher income has more influence on PV investment decision compared to the presence of subsidies in Scenario 3. The largest market is East Nusa Tenggara province whose 433 thousand rural households could afford loan instalment for PV costs. On the other hand, the net metering scheme is more enticing in fostering PV diffusions in urban area. ARISE output shows that the scheme will pull massive PV investment starting in 2021 once the electricity price is higher than the revenue requirement, i.e. USD 15.8 ¢ /kWh. The initial economic impact of Scenario 4 is USD 889 million in 2010.

5 Policy Implications

We offer two policy recommendations regarding the results of ARISE simulations. First, the government needs to transform PV grant scheme to rural PV market creation. Unattractive PV market in urban area due to the new tariff is an opportunity to shift the market to rural areas. The government should encourage PV industry to improve their technology, especially to reduce the price. One measure is to modify current subsidy scheme for IPP in rural areas from electricity consumption base to the number of customer base. Consumption-based subsidy requires power meter, electricity grid, and a labour to read the meter monthly. Such costs can be avoided in PV-based IPP by using number of customers as a basis for subsidy calculation. For example, IPP can use a solar lighting kit, a PV system with several battery-powered light emitting diode (LED) lamps. The kit does not need power meter and electricity grid; consequently, the electricity produced cannot be measured. The government may select the IPP through an auction scheme and give the subsidy either at commercial operation date (COD) or at a monthly basis. The government should also ask the banking sector to finance PV investment in rural areas. Additional capital and interest subsidies may increase PV market size in rural areas but the increase is insignificant.

In contrast, capital and interest subsidies are the key to create PV markets in urban households since existing tariff and previous FIT cannot cover the PV investment costs. Alternatively, the government could adopt the net metering scheme with automatically adjusted tariff each year to PLN's electricity generation costs. Hence,

if fossil fuel cost is continuously increasing until PLN's generation cost is higher than PV revenue requirement, the urban market will be emerged. Moreover, the urban market creation will be accelerated by the rising income of urban households.

6 Conclusions

In this article, Agent-based Renewable energy model for Indonesia Sustainable Energy (ARISE) has been developed to evaluate the effectiveness and efficiency of solar energy policy. The main feature of ARISE is the integration of engineering, socio-microeconomic, macroeconomic and environment perspectives. As results, ARISE suggests a policy reform from PV grant scheme to PV financing scheme for rural households without electricity access. Moreover, the combination of increasing income and net metering scheme are imperative factors for founding PV market in urban area.

Though ARISE has been formulated by using Indonesia data, it remains adaptive to other developing countries. Some required adjustments will be on data of income, electricity demand and incentives in each country. Nevertheless, current ARISE still has several weaknesses. First, it is based on international cost data though the data is obtained from extensive reviews of cases in both developed and developing countries. Second, household number in ARISE is only an estimation by taking sampling share of each household category in Susenas data and then multiplying it by actual total household number. Third, though households have been divided to dwelling owners and non- dwelling owners, ARISE cannot differentiate the types of dwelling, between house and apartment. This issue is important since apartment owner will be less likely to invest in PV. Fourth, ARISE employs static income growth showing negative values in several provinces. The growth should randomly change each year. Fifth, our study assumes static values for technology price and technology efficiency. Indeed, the prices are homogenous for every provinces. Six, electricity demands and other power plants in electricity grid system are not considered yet. Therefore, further research should resolve these problems including to conduct sensitivity analysis on ARISE main parameters.

Conflict of Interest Statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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