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Mitigating Agricultural Environment cost through Agricultural extension services: The Mediating role of Environmental Accounting

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The purpose of this study is to investigate ways in which to mitigate environmental costs. For this purpose, the role of "agricultural extension services" (AES) was analysed to determine the mediating role of environmental accounting. The study centred on the Thai agricultural and data was gathered from its farmers. Purposive sampling was used and subsequently data was collected from 300 Thai farmers via a questionnaire-based survey. Close-ended responses of farmers was recorded and analysed by applying "Confirmatory factor analysis" and "structure equation modelling" through SPSS and AMOS. Findings of the current study revealed that AES significantly reduces the environmental costs incurred by business because a significant negative association was found between AESs and environmental costs. It has been further discovered that environmental accounting plays a significant role in mitigating environmental expenses because environmental accounting essentially mediates the association between AES and environmental costs. The current study and findings have significant implications in theory and practice because they will assist Thai farmers to diminish costs through enhancing AESs and environmental accounting.

Key words: *Environmental costs, environmental accounting, agricultural extension services.*

Introduction

The mitigation of agricultural environment cost (AEC) has become an important global topic because of increasing environmental concerns (Kasayanond, Umam, & Jermsittiparsert, 2019; Jermsittiparsert, Siriattakul, & Sangperm, 2019) associated with agriculture. Agricultural firms incur considerable costs in order to satisfy environmental concerns associated with agriculture. At this point in time, firms are seeking ways in which to reduce their AEC through effective measures and skills. For this purpose, environmental accounting is imperative as it deals with cost, assets, liabilities and yields sold or valued in market as well as non-market items (Jamil, Mohamed, Muhammad, & Ali, 2015; Kapardis & Setthasakko, 2010). The importance of environmental accounting lies in its broad scope and application. Contrastingly, traditional accounting considers items handled as part of an annual reporting cycle.

The importance of environmental accounting in business has been emphasised by previous researchers as it plays an essential role in pricing, capital budgeting, reporting, and controlling overhead. The internal use of environmental accounting is regarded as environmental management. Through environmental accounting, firms are able to identify and systematically define the structure of environmental costs. In turn, performance enhances and strategic decisions regarding cost structure improve (Bartolomeo et al., 2000; Jasch, 2003). Core to environmental accounting is the development of an effective accounting system through which reliable estimates can be made regarding environmental damage. In this sense, environmental accounting contributes simultaneously to overall performance as well as cost reduction (Tashakor, 2019; Vasile & Man, 2012).

Figure 1 below depicts environmental performance indicators resulting from environmental accounting:

Figure 1. Green Accounting theory behind green performance (Source: New Mexico State University)

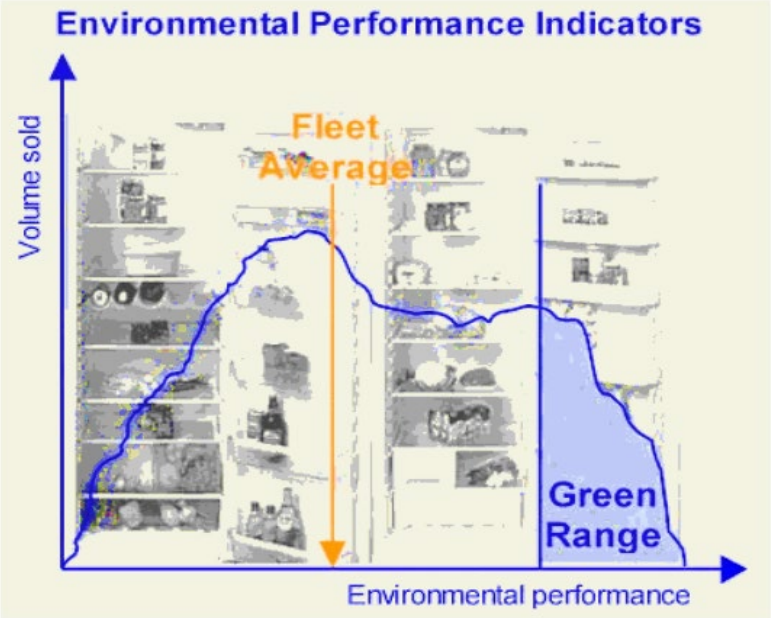


Figure 1 above attests that green accounting assists firm and business owners to understand traditional accounting methods in order to enhance performance. Since environmental accounting deals with non-market and market items, the process enables business owners to identify unnecessary costs against external influences at different points in time. In this way, firms are able to minimise wastage and avoid unnecessary expenditure, ultimately enhancing performance.

Lack of proper environmental accounting leads to poor record-keeping and accounting. Increased environmental costs may be attributed to inadequate processes as well as inappropriate products for environmental protection. Therefore, proper environmental accounting is always needed for accurate processing and attributing of costs so that they can be mitigated by effective decision making (Atnafe, Ahmed, & Adane, 2015; Bartolomeo et al., 2000; Yoon, Jang, & Lee, 2016).

Nonetheless, former research provides limited insights into the role of environmental accounting in mitigation environmental expenditure. Noticeably, only few past studies have attempted to highlight the importance of environmental accounting for a cost reduction in agriculture.

Near to 10% of Thailand's total Gross Domestic Product (GDP) is provided by its agricultural sector. There is a strong need to investigate the ways through which Thai agricultural productivity can be improved by controlling and enhancing environmental costs

and environmental performance respectively. Previous research does not provide sufficient understanding and explanation about the role of environmental accounting to lessen costs in Thailand (Gheewala et al., 2014; Jatuporn, Chien, Sukprasert, & Thaipakdee, 2011).

Therefore, the current study attempts to address the research gap be examining the role of environmental accounting. Importantly, the role of Agricultural Extension Services (AES) is noticeable because it, too, has a role in environmental accounting. AES refers to the advisory services through which information is provided to farmers to enhance their abilities and productivity. AES is regarded as a central application of 'scientific research and knowledge' in farmer literacy. These AESs enhance farmers' abilities to understand pressing environmental concerns and through environmental accounting, to understand and act on unnecessary costs to make effective decisions about environmental protections (Dimelu & Anyaiwe, 2011).

In order to address the gaps in research and associated literature, this study analyses the impact of AES on environmental costs and the role environmental accounting plays in the Thai agricultural industry. The key aspects examined in this paper are 'upfront environmental costs, conventional environmental costs, future environmental costs, potentially environmental costs, voluntary environmental costs, and image/relation environmental costs'. This study provides a review of relevant literature, methodological points, analysis and discussion of results and the conclusion and recommendations of the study.

Literature Review

Agricultural Extension services and upfront environmental costs

Studies by Ghaemmaghami, Zamani, and Shafiei (2018) explore the impact and role of agricultural extension services (AES) on upfront environment costs (UEC). AES aids in the development of Green Agriculture Extension Theory (GAET) (Stone, 2016) to examine the basic premises of ecological modernisation by applying agricultural extension polices to generate basic forms of service. All extension services activities are considered premeditated, goal oriented, planned and accurately programmed because of evidence provided by practices related to diffusion or green theory (Chan & Ma, 2016). These theories further explain the functioning of AES and demonstrate a substantial impact on UEC. Studies (Berto, Stival, & Rosato, 2018) believe AES increases because of certain factors: current and emerging technologies, hiring of more literate farmers, transferring basic, relevant knowledge and information and, lastly, offering technical and economical advice. The studies (Quintana, 2015) conclude that UEC decreases as a result of lost cost and expense.

Thus, the following hypothesis is proposed:

H1: That Agricultural Extension Services have a significant impact on Upfront Environmental Costs.

Agricultural Extension Services and Conventional environmental Costs

Studies by Gopal et al. (2017) suggest a connection between AES and CEC on the basis of empirical evidence. This comes about from the application of the Theory of Diffusion (Munir & Davidson, 2017). Diffusion theory is defined as the theoretical base of agriculture extension and deals with environmental, structure of farming and machinery costs. In light of a global increase in modernisation, the latest farming and agricultural methods are inherited (Premakumara & Hengesbaugh, 2017) and adopted to meet the international standards. This, however, has an adverse effect on conventional farming and agriculture methods aimed at decreasing conventional environmental costs.

Select studies (Adnan, Nordin, Rahman, & Noor, 2017) assert that environmental quality produces a negative impact on CEC. AES develops awareness in farmers so that crop yield and yearly production can increase and, at the same time, decrease CEC. Still, many studies (Tanabe, 2018) analyse the impact of a literate farmer on promoting education and strengthening extension services, subsequently resulting in a negative impact on CEC. Many agricultural companies and industries cite environmental costs as their main overhead and responsible for inaccurate recording. Inaccurate recordings provide false information and poorly inform any decisions about environmental protection programs.

Thus, the following hypothesis is proposed:

H2: That Agricultural Extension Services have a significant impact on Conventional Environmental Costs.

Agricultural Extension Services and Future Environmental cost

Welsh-Huggins and Liel (2016) examine the relationship between AES and future environmental costs (FEC) in the agricultural sector. Financial or environmental costs depend on the effect and efficacy of business performance together with ecological-environmental sustainability. Some studies (van de Bank & van de Bank, 2018) affirm that agriculture extension services do not maintain the sustainability of agricultural farming or business. In fact, it is diffusion theory and its application that promotes agricultural sustainability at all levels. The downside is that it has a negative impact on FEC.

Accounting systems, as cited in this study, play a vital role in the reduction of FEC in conjunction with AES. At the same time, it needs to be acknowledged that developed

countries struggle because of increasing popularity of the 'Green Revolution' (Jo, Wang, Kangasharju, & Muehlhaeuser, 2018). The 'Green Revolution' requires the latest technology to achieve sustainable agricultural growth and increased funding in order to maintain that growth. Select studies (Premakumara & Hengesbaugh, 2017) have investigated the impact of the 'Green Revolution' and found that a scarcity of soil reduces the availability of fertile land and causes genetic diversity of crops. Subsequently, a negative impact on FEC is apparent.

Thus, the following hypothesis is proposed:

H3: That AES has a significant impact on FEC.

Agriculture Extension Services and Potentially Environmental Costs

According to van de Bank and van de Bank (2018), AES was established to support agricultural production processes and select extension services and activities. The Diffusion and Green Revolution theories provide a connection between AES and potential environmental costs (PEC) which underscores the concept of growth and environmental production. Nonetheless, this accounts for a negative impact on PEC owing to modernisation and diffusion of technologies. Likewise, progressive farmers with new ideas, concepts and different types of modern production systems provide a negative effect on PEC.

The negative impact of agricultural extension activities on the environment (Froomkin, 2015) has been examined by many theorists and specialists who indicate that contemporary technologies do not promote sustainability. Instead, they greatly contribute to environmental degradation: the natural environment losses its potential value and cost (Obarska-Pempkowiak, Gajewska, Wojciechowska, & Pempkowiak, 2015).

Thus, the following hypothesis is proposed:

H4: That AES has a significant impact on PEC.

Agricultural Extension Services and Voluntary Environmental Costs

Froomkin (2015) advocates for AES sustainability at a global level but considers the diverse effects on the practices of voluntary environmental costs (VEC). Skilled farmers know how to maintain agricultural land, providing it with suitable nourishment and care. On the other hand, inefficient and unknowledgeable farmers lose large areas of fertile and irrigated land. Select researchers believe that this comes about because extension agents, including farmers, stakeholders, producers and agricultural researchers, do not have the expertise or exemplary knowledge about land and environmental management. Diffusion theory (Aizstrauta, Ginters, & Eroles, 2015) shows the moderate effects of agricultural management on extension

services and the resulting negative impact on VEC. VEC decrease when the impact on environmental AES increases. Nonetheless, there is still a (Palade, 2016) need for a comprehensive and dynamic framework to set the objectives of extension services.

Thus, the following hypothesis is proposed:

H5: That AES has a significant impact on VEC.

Agricultural extension Services and image/relation environmental costs

Studies (Nagar, 2015) present various issues such as development perspective, sustainability and agricultural knowledge systems as the determinants used for the purpose of extension perspectives and objectives. AES and AKS both have an adverse effect on the image/relation of EC due to inefficient sustainable extension efforts that are responsible for the destruction of a resourceful and valuable environment. However, diffusion theory and its practices have been criticised by specialists on different grounds (Lee, 2008). This criticism arises because of the loss of valuable environments through the use more chemicals, pesticides and fertilisers that increase crops production. On the other hand, such an approach destroys the fertility of soil because the farming land becomes useless for the further cultivation of crops. Many researchers (Lee, 2008) consider the issue of social and environmental problems along with the reduction in costs of image/relation related to environment.

Thus, the following hypothesis is proposed:

H6: That AES has a significant impact on image/relation EC.

Mediating role of Environment accounting

Other studies in the field (Saeidi, Sofian, Saeidi, Saeidi, & Saaeidi, 2015) see environmental accounting (EA) as comprehensive in its purpose. EA provides some reports for inter-organisational and extra-organisational users. EA assists management decision and helps in pricing, controlling overheads, capital budgeting and disclosure of information to the public about benefits and the financial community. Researchers (Watson, 2015) believe that environmental cost structure depends completely on the role of EA. This is why EA plays a moderating role on UEC. Accounting policies include sustainability strategies and social costs in pollution control. Many researchers base their perspectives on environmental accounting theory (Libby, 2017) to enrich the theoretical basis of EA and its reports. EAT increases the impact of EA on AES and subsequently decreases the value of UEC. However, strategic decision makers debate the competitive and improved performance of cost structures EA on a short- and long-term basis.

Thus, the following hypothesis is proposed:

H7: That EA has a significant mediating role between AES and UEC.

Studies (Fraj, Matute, & Melero, 2015) analyse the effect of the mediating role of EA on CEC. This study elaborates on the influence of EA on environmental economies. These only develop when accounting systems are appropriate and record reliable estimates of environmental damage according to the application and practices of environmental accounting theory (EAT). EAT gives theoretical evidence (Hanley, Shogren, & White, 2016) regarding the performance of EA in sensitive environmental industries that are not benefitting from disclosed environmental and social information as a tool for attaining legitimacy. However, CEC faces a lot of pressure and little regulatory requirements for environmental compliance issues.

Thus, the following hypothesis is proposed:

H8: That EA has a significant mediating role between AES and CEC.

In recent studies (El Ghoul, Guedhami, & Pittman, 2016) EA is seen as a mediator on FEC along with the empirical evidence referring to EA theory (Libby, 2017). This defines the environmental pollution as a main cause for the decline in FEC. This contamination destroys land, environment and water through artificial fertilisers and chemicals and causes severe disruption in the environmental system and aquatic lifecycle. Therefore, environment protection agencies are still working in collaboration with agricultural management to develop certain extension services to preserve these natural habitats for future generations. AES works along with EA to decrease environmental costs which are considered as a future perspective.

Thus, the following hypothesis is proposed:

H9: That EA has a significant mediating role between AES and FEC.

Another recent study (González-Rodríguez, Díaz-Fernández, & Simonetti, 2015) affirms that the mediating role of EA depends on the financial status of agricultural business and farming management systems. These gradually causes a decrease in the PEC and expenses related to environmental changes and economic growth. EA theory gives evidence on the potential of environmental protection agencies (EPA) which can help in the reduction of environmental crime and risks with the use of EA benefits and future protection approaches. Environmental costs, capital and currency decrease with the increase in AES and EA. However, environmental costs can remain hidden in overhead accounts or otherwise be overlooked by

the specialists or agricultural researchers. Nonetheless, its potential still remains negligible as per studies (Baldini, Dal Maso, Liberatore, Mazzi, & Terzani, 2018).

Thus, the following hypothesis is proposed:

H10: That EA has a significant mediating role between AES and PEC**.**

Authors of the study (Schaltegger, Burritt, & Petersen, 2017) relate the mediating role of EA to environmental accounting benefits which have a negative effect on VEC. EA theory suggests the definable connection of environmental hazards with environmental cost liabilities, cost accounting and environmental performance. This is because organisations and different business units may suffer large payment crises or cost loss due to the development and implementation of environment management systems. Therefore, VEC will be seriously affected by EA, through which it can lose its financial position and liquidity (Bennett & James, 2017).

Thus, the following hypothesis is proposed:

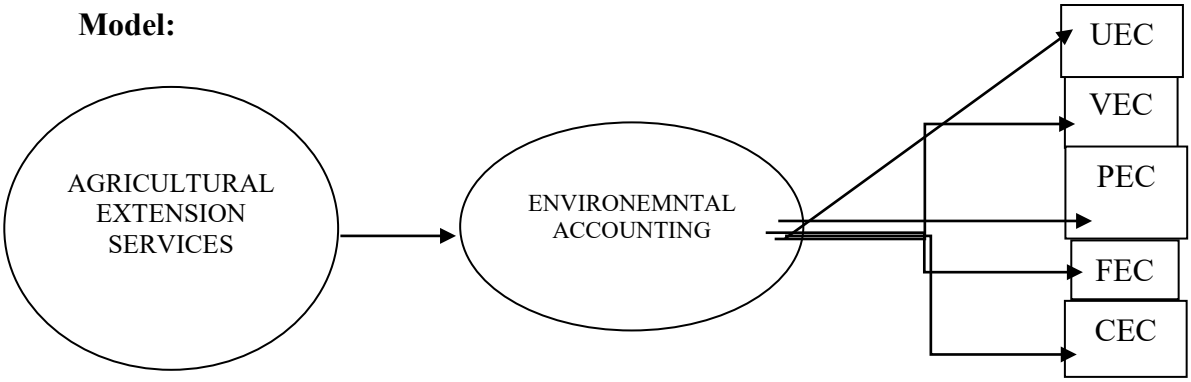
H11: That EA has a significant mediating role between AES and VEC.

According to a theoretical study (Qiu, Shaukat, & Tharyan, 2016), environmental accounting depends on the finances, expenses, economic growth and normal expenditure of business and agriculture management to hide and lessen the costs of image/relation of environment. These costs might be neglected or may be forgotten by the analysts or managers overcoming the operation cost of the production, system design or provision (Schaltegger & Burritt, 2017) requirements. Probable or image/relation costs lessen because of the influence of management thinking, customers, employees and society who are seen as image/relation costs. However, these costs convince current and potential customers about the nature of agriculture management, AES and EA.

Thus, the following hypothesis is proposed:

H12: That EA has a significant mediating role between AES and image/relation EC.

Model:



Methodology

Population and Sampling

This study examined how agriculture extension services lessen the agriculture environmental cost in a mediating role of environmental accounting. Researchers aim to investigate how to lessen environmental costs in the agricultural sector, hence selecting Thailand. The country's population and respondents are farmers because only farmers can reduce the environmental cost by implementing advanced technologies which they learned through environmental accounting and agriculture extension services. In sampling, the main vexing point is the sample size if a researcher uses structure equation modelling for analysis. Moreover, Hazen et al. (2015) reported that SEM is a "lager sample' analytical approach. For selecting sample size, researchers referred to Klein (2015) who stated that the number of items*10 raised the sample size. In this study almost 300 questionnaires were distributed among respondents, out of which 240 responses were received. After deleting invalid responses, 207 responses were considered acceptable. Furthermore, farmers had been selected with the help of purposive sampling because the objectives of the study can only be fulfilled by farmers.

Data Collection and Procedures

The researcher considered a questionnaire the best data collection method for this quantitative study because the questionnaire consisted of close ended questions and response. The researcher obtained this in numeric form and can be easily analysed statistically. Before finalising the questionnaire, the researcher checked two aspects: that they language used must be Thai as it is the language of farmers and, the other, the content validity of scale used in the questionnaire. As farmers' literacy is low and they have no online services, the researcher self-administered the questionnaire.

Validity, Reliability and Common Bias

Reliability of data collection has been assessed by SPSS and the criteria used to examine it was that Cronbach's α must be larger than 0.7 (Chin, 1998). As far as validity is concerned, both convergent validity and discriminant validity has been assessed by AMOS but the criteria to examine them are different. The Three criteria used to examine convergent validity were (i) items loading larger than 0.70 and statistical significance, (ii) composite construct reliability which has to be larger than 0.80 and (iii) average variance extracted larger than 0.50. Criteria used to examine discriminant validity between the construct was that the square root of AVE must be larger when correlated with other constructs.

Common bias is generated when the respondent uses the same measures which are recommended by a common rate (Donaldson & Grant-Vallone, 2002; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003) for explanatory variables. In this study, variables are different such

as agriculture extension services knowledge, agriculture environmental cost and environmental accounting. This is why the risk of common bias has been observed. To lessen this risk, the test used by the researcher was Harman's Single Factor Test. All items of constructs have been included for factor analysis in order to check whether all variables were accounted for by single factor. Outcomes described that all constructs withdraw as different factors; that is 87% of total variance described by factor solution and 17% of variance described by one factor. To conclude the inexistence of a common method bias and single factor does not account for the most covariance.

Measurement

The questionnaire is a critical step in primary research because it is necessary to choose an appropriate and accurate scale for the measurement of constructs used in the study. The following study adopts the measurement of every variable from reliable and published resources. The scale of agricultural extension services was adopted from the study of (Aker, 2011; Benjamin, 2014), which has ten items. The scale of environmental management accounting benefits was adopted from the study of (Ghaemmaghami et al., 2018) with four items. The six items of environmental cost were investigated in this study and their scale was obtained from the study of (Ghaemmaghami et al., 2018) which has a total of fourteen items.

Hypothesis Testing

In this study, hypothesis testing has been done by Structural Equational Modelling (SEM), which was run on AMOS. Path analysis was done in two steps: the first one to estimate standardised paths and, the second, to estimate the statistical significance of an influenced path. Moreover, the researcher evaluates the relationship of hypotheses such as agriculture environment cost, agriculture extension services knowledge and environmental accounting in order to check which relationship is proven or which is rejected.

Empirical Findings

Empirical data collected from 300 participants was used and responses of 207 respondents were included in the analysis after screening blank and missing responses. The relationships, with the help of a self-administrative questionnaire, were analysed by using SPSS and Amos. It is a necessity of analysis to run preliminary tests in order to check the reliability, normality, and validity of data. The researcher applied the Frequency Distribution Test in order to check the respondent profiles. The findings showed that 133 males and 174 females participated in this study. Most respondents had an undergraduate degree; whereas 128 respondents a Master's degree, 23 respondents an intermediate degree and 11 another degree. The respondents who participated in this study were mostly young and their age. The age range

lay between 30 to 40 years, whereas 40 respondents ranged from 21 to 30 years and only 1 respondent was aged more than 40 years.

Reliability test

To check the reliability of the data, the Cronbach Alpha test was applied in order to investigate the factor loading of each construct.

Table 1 below presents the outcome of Cronbach Alpha test;

Table 1: Reliability Test

Variable	No of items	Cronbach Alpha
UEC	2	0.763
REC	3	0.922
EMB	4	0.921
FEC	2	0.728
PEC	2	0.875
AES	10	0.956
CEC	2	0.783
VEC	3	0.910

In the Table 1 above, the Cronbach Alpha value for agricultural Extension Service is .956 and for environmental management accounting benefits.921, Similarly, UEC, REC, FEC, PEC, CEC and VEC showed a value of Cronbach alpha as .763, .922, .728, .875, .783 and .910 respectively. The value of Cronbach alpha for each variable is greater than .70.

Convergent and Discriminant Validity

A validity master sheet was used to confirm the convergent and discriminant validity of the research model variables. Discriminate validity provided the discrimination between variables while the convergent validity was measured with the help of composite reliability and average variance extracted.

Table 2 below presents the results of both validities:

Table 2: Convergent and Discriminant Validity

	CR	AVE	MSV	UEC	REC	EMB	FEC	PEC	AES	CEC	VEC
UEC	0.763	0.499	0.220	**0.707**							
REC	0.922	0.797	0.608	-0.171	**0.893**						
EMB	0.921	0.745	0.411	0.023	0.540	**0.863**					
FEC	0.728	0.582	0.072	0.269	0.128	0.024	**0.763**				
PEC	0.875	0.777	0.411	-0.028	0.564	0.641	0.006	**0.882**			
AES	0.966	0.743	0.440	-0.026	0.622	0.537	0.058	0.603	**0.862**		
CEC	0.783	0.523	0.220	0.469	-0.089	0.023	0.199	-0.033	0.044	**0.723**	
VEC	0.910	0.770	0.708	-0.148	0.953	0.563	0.093	0.582	0.663	-0.096	**0.878**

In Table 2 above, results of convergent and discriminant validity show that the overall model is a good fit because the composite reliability of each variable is more than 70%. The average variance extracted is more than 50% while the discriminant validity shows that loading of each variable discriminates from others. Every variable has a maximum loading with itself as compared to others. These validities prove the authenticity of collected data.

Confirmatory Factor Analysis

Confirmatory Factor Analysis is a test which used to confirm the fitness of a hypothetical model before Structural Equation Modelling is applied. Different measures are used to confirm the fitness of the model.

Table 3 below presents each indicator and its observed value for the current study:

Table 3: CFA

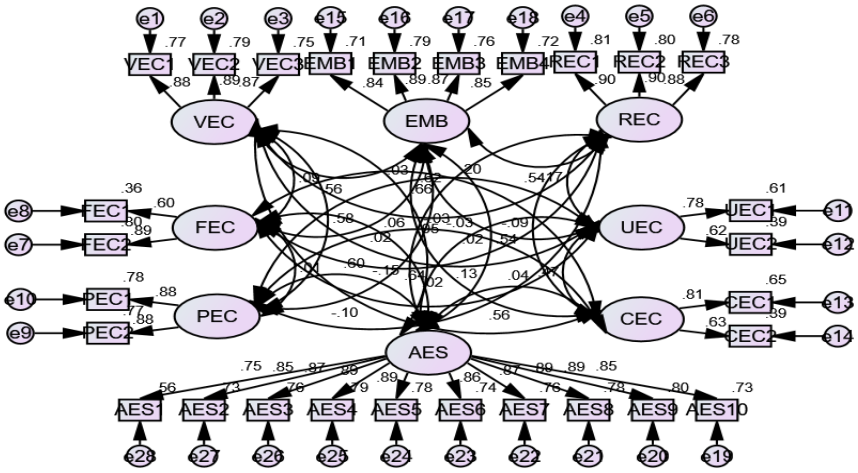
Indicators	Threshold range	Observed value
CMIN/DF	>3	2.021
GFI	<0.80	.866
IFI	<0.80	.954
CFI	<.080	.955
RMSEA	>.08	.58

In Table 3 above, all indicators of model fitness show that observed values are under the range limit. For example, the value of CMIN/DF is 2.021 and less than 3. The value of GFI is

0.866 which is greater than 0.80. Similarly, the value of CFI and IFI is greater than 0.90. Lastly, but not the least indicator, is RMSEA and its value is less than .08. Evidently, these indicators prove that the model is a good fit.

Figure 2 below is a Screenshot of CFA:

Figure 2. CFA



Structural Equation Modeling

Structural Equation Modelling is a multivariate regression analysis which is used mostly in primary data to simultaneously confirm the hypothesis of the study. SEM provides the facility of direct regression and indirect regression tests in a single structural model.

Table 4 below shows the results of Structural Equation Modelling:

Table 4: SEM

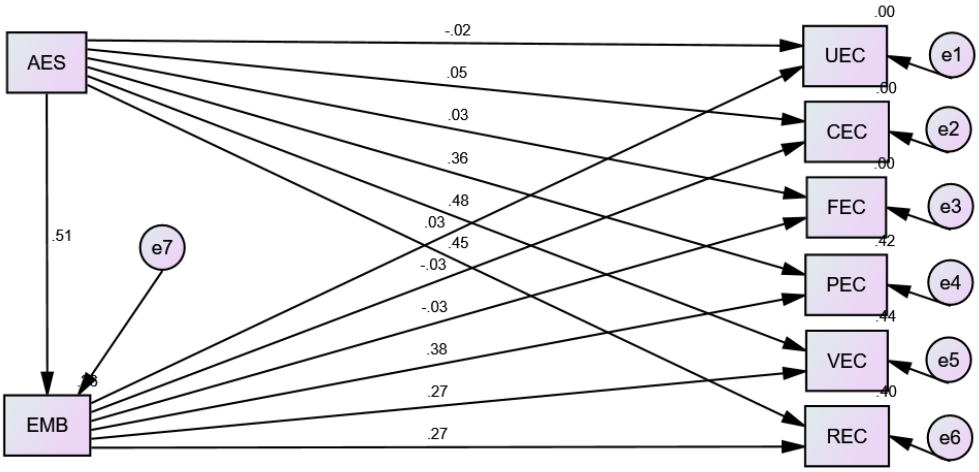
Total Effect	AES	EMB
EMB	.511***	.000
REC	.587***	.266**
VEC	.621***	.274**
PEC	.559***	.380***
FEC	.009	-.033
CEC	.037*	-.028
UEC	-.003	.028
Direct Effect	AES	EMB

Total Effect	AES	EMB
EMB	.511***	.000
REC	.451***	.266**
VEC	.481***	.274**
PEC	.365***	.380**
FEC	.026	-.033
CEC	.051*	-.028
UEC	-.018	.028
Indirect Effect	AES	EMB
EMB	.000	.000
REC	.136**	.000
VEC	.140**	.000
PEC	.195***	.000
FEC	-.017	.000
CEC	-.014	.000
UEC	.014	.000

The results of structural equation modelling indicated in Table 4 above demonstrate the direct effect of agricultural Extension Service on environmental management accounting. The benefit stands at 51% which means that a unit increase of agricultural Extension Service will bring 51% positive change in environmental management accounting. The direct impact of agriculture Extension Services on upfront environmental costs, conventional environmental costs and future environmental costs is insignificant. However, the impact on potential environmental cost, voluntary environmental cost and image/relation environmental cost is significant. This means that three direct hypotheses are rejected and the remaining three are accepted. Similarly, environmental management accounting benefits significantly mediate the relationship between independent and the last three dependent variables. Its mediating role between AES and the first three dependents is insignificant.

Figure 3 below presents a SEM screenshot;

Figure 3. SEM Screenshot



Discussion and conclusion

Discussion

The aim of the study was to investigate the relationship between agricultural extension services and agricultural environment costs. This study took environmental accounting (EA) to be a mediating variable between AES and AEC. The first hypothesis proposed that, 'agricultural extension services (AES) have a significant impact on agricultural environment costs (AEC) that are, upfront environmental costs (UEC), conventional environmental costs (CEC), future environmental costs (FEC), potentially environmental costs (PEC), Voluntary environmental costs (VEC), image/relation environmental costs (IREC)' (Cohen & Lemma, 2011). The results of the study showed that this hypothesis is proven, and that AES has a significant and negative impact on AEC. The impact of AES on conventional, upfront, and future environmental costs was insignificant while the impacts of AES on other environmental costs were significant.

This relationship is also confirmed by Xinping Chen study on producing more with fewer costs. The study states that agricultural extension services demand to finance both on the end of educating the farmers and then for the implementation of techniques, methods, and materials on the agricultural sector (Sanga, Kalungwizi, & Msuya, 2013). This means that AES significantly impacts AEC. This impact effects the budget decided for the agricultural sector as it might fluctuate and change in order to apply new techniques for the betterment of the farming sector (Aker, 2011).

The second hypothesis proposed that 'environmental accounting has a significant mediating role between agricultural extension services and agricultural environment costs'. this hypothesis is proven as studies reveal that environmental accounting really has a significant mediating role between AES and AEC. Valli Manickam, in *Environmental Management*,

stated that 'environmental accounting contains all of the information about the company that how much of the natural or other resources a company or a sector is utilising and how much return is it giving' (Labarthe & Laurent, 2013). This also shows the impact of that sector on the environment. The increase in the trend and implementation of AES in agriculture will increase the trends of all farmers towards it and impact the overall budget of the agricultural sector.

Obviously, this cannot be overlooked as highly effective environmental accounting consists of large amounts of resources that cause fluctuations in environmental accounting. Subsequently, this will cast a high and negative impact on the AEC as all costs will increase with educating and he implementing activities in the agricultural sector (Benin et al., 2011).

Conclusion

This research was carried out in order to examine the relationship between agricultural extension services and agricultural environment costs. This study took environmental accounting (EA) as a mediating variable between AES and AEC. Data collection was carried out via a questionnaire. A sample of three hundred farmers from Thailand was taken. Different analytical techniques were applied to the data and the results demonstrated that AES has a negative impact on AEC. Therefore, environmental accounting significantly mediates between AES and AEC.

Practical, theoretical and policy-making implications of the study

This study has contributed to and increased the data available on the impact of AES on AEC in the literature. This study has also taken 'environmental accounting' as the mediator between AEC and AES. This approach represents a significant move forward in the available research literature as the concept of mediator had not been considered. This study can be used in the policymaking process to gain maximum yields by spending the lowest on agricultural efficiency techniques. The agricultural sector can practically implement AES with farmers by keeping the costs controlled. This study shows how this can be achieved.

Limitations and future research indications

This study was conducted in Thailand only. Yet, the problem of high costs and low yield is global so this study can be conducted outside of Thailand using the same variables but in a different setup. This study targeted AEC only. However, hurdles to high yields can also be considered in order to understand the constraints in the agricultural sector and to make and implement policies for farmers. To achieve this, researchers must understand farmers' viewpoints to determine the investment amount for an ideal yield. Future researchers are encouraged to conduct surveys of larger samples and then present and recommend on results of similar variables.

REFERENCES

Adnan, N., Nordin, S. M., Rahman, I., & Noor, A. (2017). Adoption of green fertilizer technology among paddy farmers: a possible solution for Malaysian food security. *Land use policy, 63*, 38-52.

Aizstrauta, D., Ginters, E., & Eroles, M.-A. P. (2015). Applying theory of diffusion of innovations to evaluate technology acceptance and sustainability. *Procedia Computer Science, 43*, 69-77.

Aker, J. C. (2011). Dial "A" for agriculture: a review of information and communication technologies for agricultural extension in developing countries. *Agricultural Economics, 42*(6), 631-647.

Atnafe, A. D., Ahmed, H. M., & Adane, D. M. (2015). Determinants of adopting techniques of soil and water conservation in Goromti Watershed, Western Ethiopia. *Journal of Soil Science and Environmental Management, 6*(6), 168-177.

Baldini, M., Dal Maso, L., Liberatore, G., Mazzi, F., & Terzani, S. (2018). Role of country- and firm-level determinants in environmental, social, and governance disclosure. *Journal of Business Ethics, 150*(1), 79-98.

Bartolomeo, M., Bennett, M., Bouma, J. J., Heydkamp, P., James, P., & Wolters, T. (2000). Environmental management accounting in Europe: current practice and future potential. *European Accounting Review, 9*(1), 31-52.

Benin, S., Nkonya, E., Okecho, G., Randriamamonjy, J., Kato, E., Lubade, G., & Kyotalimye, M. (2011). Returns to spending on agricultural extension: the case of the National Agricultural Advisory Services (NAADS) program of Uganda. *Agricultural Economics, 42*(2), 249-267.

BENJAMIN, E. (2014). FARMERS' PERCEPTION OF EFFECTIVENESS OF AGRICULTURAL EXTENSION DELIVERY TOWARDS AQUACULTURE DEVELOPMENT IN EBONYI STATE. *THE INTERNATIONAL RESEARCH JOURNAL "INTERNATIONAL RESEACHERS", 3*(3).

Bennett, M., & James, P. (2017). *The Green bottom line: environmental accounting for management: current practice and future trends*: Routledge.

Berto, R., Stival, C. A., & Rosato, P. (2018). Enhancing the environmental performance of industrial settlements: An economic evaluation of extensive green roof competitiveness. *Building and Environment, 127*, 58-68.

Chan, C., & Ma, T. (2016). Energy efficiency housing in South Australia–A gap analysis between the expected and actual benefits. *Procedia engineering, 164*, 446-452.

Cohen, M. J., & Lemma, M. (2011). Agricultural extension services and gender equality. *International Food Policy Research Institute Discussion paper, 1094*, 1-44.

Dimelu, M., & Anyaiwe, V. (2011). Priorities in smallholder oil palm producers in Ika local government area of Delta state: Implication for agricultural extension service in Nigeria. *World journal of agricultural sciences, 7*(2), 117-123.

El Ghoul, S., Guedhami, O., & Pittman, J. (2016). Cross-country evidence on the importance of Big Four auditors to equity pricing: The mediating role of legal institutions. *Accounting, Organizations and Society, 54*, 60-81.

Fraj, E., Matute, J., & Melero, I. (2015). Environmental strategies and organizational competitiveness in the hotel industry: The role of learning and innovation as determinants of environmental success. *Tourism Management, 46*, 30-42.

Froomkin, A. M. (2015). Regulating Mass Surveillance as Privacy Pollution: Learning from Environemntal Impact Statements. *U. Ill. L. Rev.*, 1713.

Ghaemmaghami, K., Zamani, M., & Shafiei, H. (2018). Investigating environmental accounting and its role in reducing environmental costs (case study: Iran Noubaft textile company). *Journal of Accounting, Finance and Auditing Studies, 4*(4), 185-202.

Gheewala, S., Silalertruksa, T., Nilsalab, P., Mungkung, R., Perret, S., & Chaiyawannakarn, N. (2014). Water footprint and impact of water consumption for food, feed, fuel crops production in Thailand. *Water, 6*(6), 1698-1718.

González-Rodríguez, M. R., Díaz-Fernández, M. C., & Simonetti, B. (2015). The social, economic and environmental dimensions of corporate social responsibility: The role played by consumers and potential entrepreneurs. *International Business Review, 24*(5), 836-848.

Gopal, A. R., Karali, N., Sharpe, B., Delgado, O., Bandivadekar, A., & Garg, M. (2017). Improved heavy-duty vehicle fuel efficiency in India, benefits, costs and environmental impacts: Lawrence Berkeley National Lab.(LBNL), Berkeley, CA (United States).

Hanley, N., Shogren, J. F., & White, B. (2016). *Environmental economics: in theory and practice*: Macmillan International Higher Education.

Jamil, C. Z. M., Mohamed, R., Muhammad, F., & Ali, A. (2015). Environmental management accounting practices in small medium manufacturing firms. *Procedia-Social and Behavioral Sciences, 172*, 619-626.

Jasch, C. (2003). The use of Environmental Management Accounting (EMA) for identifying environmental costs. *Journal of Cleaner production, 11*(6), 667-676.

Jatuporn, C., Chien, L.-H., Sukprasert, P., & Thaipakdee, S. (2011). Does a long-run relationship exist between agriculture and economic growth in Thailand. *International Journal of Economics and Finance, 3*(3), 227-233.

Jermsittiparsert, K., Siriattakul, P., & Sangperm, N. (2019). Predictors of Environmental Performance: Mediating Role of Green Supply Chain Management Practices. *International Journal of Supply Chain Management, 8*(3), 877-888.

Jermsittiparsert, K., Sutduean, J., & Sutduean, C. (2019). Sustainable Procurement & Sustainable Distribution Influence the Organizational Performance (Economic, Social and Environmental): Moderating Role of Governance and Collaboration at Thai Food Industry. *International Journal of Supply Chain Management, 8*(3), 83-94.

Jo, S.-K., Wang, L., Kangasharju, J., & Muehlhaeuser, M. (2018). *Cost-Effective and Eco-Friendly Green Routing Using Renewable Energy.* Paper presented at the 2018 27th International Conference on Computer Communication and Networks (ICCCN).

Kapardis, M. K., & Setthasakko, W. (2010). Barriers to the development of environmental management accounting. *EuroMed Journal of Business*.

Kasayanond, A., Umam, R., & Jermsittiparsert, K. (2019). Environmental Sustainability and its Growth in Malaysia by Elaborating the Green Economy and Environmental Efficiency. *International Journal of Energy Economics and Policy, 9*(5), 465-473.

Labarthe, P., & Laurent, C. (2013). Privatization of agricultural extension services in the EU: Towards a lack of adequate knowledge for small-scale farms? *Food policy, 38*, 240-252.

Lee, K. (2008). Opportunities for green marketing: young consumers. *Marketing intelligence & planning, 26*(6), 573-586.

Libby, R. (2017). Accounting and human information processing *The Routledge Companion to Behavioural Accounting Research* (pp. 42-54): Routledge.

Munir, A., & Davidson, A. (2017). *Privatization and the Crisis of Agricultural Extension: The Case of Pakistan: The Case of Pakistan*: Routledge.

Nagar, K. (2015). Modeling the effects of Green advertising on brand image: Investigating the moderating effects of product involvement using structural equation. *Journal of Global Marketing, 28*(3-5), 152-171.

Obarska-Pempkowiak, H., Gajewska, M., Wojciechowska, E., & Pempkowiak, J. (2015). Treatment wetlands for environemntal pollution control.

Palade, B. (2016). Greenwashing Strategy and Environmental Obligations: The Volkswagen Case. *Governing for the Future: Interdisciplinary Perspectives for a Sustainable World*, 97-104.

Premakumara, D. G. J., & Hengesbaugh, M. (2017). Editorial Team Mandalay City Development Committee (MCDC): U Thit Sinn, U Hla Myo, U Than Htut, U Soe Tint Aung, U Min Aung Phyoe Environemntal Conservation Department (ECD), MONREC: U Hla Maung Thien, U Min Maw, Ni Ni Thin IGES Centre Collaborating with UNEP on Environmental Technologies (CCET): Kazunobu Onogawa.

Qiu, Y., Shaukat, A., & Tharyan, R. (2016). Environmental and social disclosures: Link with corporate financial performance. *The British Accounting Review, 48*(1), 102-116.

Quintana, J. (2015). Small-scale wave motion energy generator: Technical & Business parallel development.

Saeidi, S. P., Sofian, S., Saeidi, P., Saeidi, S. P., & Saaeidi, S. A. (2015). How does corporate social responsibility contribute to firm financial performance? The mediating role of competitive advantage, reputation, and customer satisfaction. *Journal of Business Research, 68*(2), 341-350.

Sanga, C., Kalungwizi, V., & Msuya, C. (2013). Building agricultural extension services system supported by ICTs in Tanzania: Progress made, Challenges remain. *International Journal of Education and Development using ICT, 9*(1), 80-99.

Schaltegger, S., & Burritt, R. (2017). *Contemporary environmental accounting: issues, concepts and practice*: Routledge.

Schaltegger, S., Burritt, R., & Petersen, H. (2017). *An introduction to corporate environmental management: Striving for sustainability*: Routledge.

Stone, G. D. (2016). Towards a general theory of agricultural knowledge production: environmental, social, and didactic learning. *Culture, Agriculture, Food and Environment, 38*(1), 5-17.

Tanabe, I. (2018). Environmental-Friendliness in the Manufacturing Field. *International Journal of Environmental Pollution and Remediation, 5*(1), 1-9.

Tashakor, S. (2019). Environmental management accounting practices in Australian cotton farming. *Accounting, Auditing & Accountability Journal, 32*(4), 1175-1202. doi: 10.1108/AAAJ-04-2018-3465

van de Bank, M., & van de Bank, C. (2018). The business of climate change: A perspecitve of environemntal performance on the tourism industry. *African Journal of Hospitality, 7*(2), 1-14.

Vasile, E., & Man, M. (2012). Current dimension of environmental management accounting. *Procedia-Social and Behavioral Sciences, 62*, 566-570.

Watson, L. (2015). Corporate social responsibility research in accounting. *Journal of Accounting Literature, 34*, 1-16.

Welsh-Huggins, S., & Liel, A. (2016). *Is a Stronger Building also Greener? Influence of Seismic Design Decisions on Building Life-Cycle Economic and Environmental Impacts.* Paper presented at the Life-cycle of engineering systems: emphasis on sustainable civil infrastructure: proceedings of the fifth international symposium on life-cycle civil engineering (IALCCE 2016), 16–19 October 2016.

Yoon, D., Jang, J., & Lee, J. (2016). Environmental management strategy and organizational citizenship behaviors in the hotel industry: The mediating role of organizational trust and commitment. *International Journal of Contemporary Hospitality Management, 28*(8), 1577-1597.