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Research Article

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Driving and Inhibiting Factors of Farmer Behaviour in Using Animal Manure: An Empirical Study on the Maize Farming

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Abstract

The purpose of this study is to identify and determine the driving and inhibiting factors of the farmers 'behaviour in the use of animal manure in the maize farming. The data were collected from the survey of the sample comprising 144 farmers in the Jeneponto and Bone Regencies in the province of South Sulawesi. Data analysis was conducted using non-parametric Spearman correlation. The results of the study showed that in terms of the farmers' attitude variable, attitude towards productivity, observability, reliability, and complexity was found to bean inhibiting factor, whereas the driving factors encompassed attitude towards relative advantage, perception that animal manure is environment pollutants, and animal manure as a source of fertilizer. In terms of subjective norm variable, the role of government, media, and other farmers were deemed as the cardinal driving factors. Finally, in terms of the behavior as the dependent variable, the inhibiting factors included time, habit, initial experiences, risks, availability of household labor force, availability of animal manure, access to manure market were regarded as main inhibiting factors, whereas its main driving factor was triableness.

Key words: *Farmer behaviours, drivers and inhibitors, animal manure, maize farming*

Introduction

Maize is one of the major raw materials for the poultry feeds industry. The fast growing poultry feed industry boosts the increasing demand for maize. According to the Trade Policy Analysis and Development Agency (2018) the maize need for the raw materials of annual poultry feed industry is estimated to reach 8.5 millions of tonnes ad only 40% can be met by the domestic manufacturing of maize. There are still wide-open opportunities to elevate domestic maize production through enhanced productivity and the exploiting of potential vast land areas. However, the increase in maize production is determined by improving productivity (the increase rate of 4.17% per year) rather than by increasing harvested area (increase rate of 0.96% per year) (Zubachtirodin et al., 2012). In efforts to speed up the increase in productivity, the dwindling soil fertility and the diminished soil nutrients have been considered a major threat (Haryono 2012 and Sutoro 2015). Consequently, the farm average productivity level of maize over the past 10 years is inclined to be on the decline and is now estimated to range between 2.3 -3.47 tons per hectare which is relatively far lower than the 4.63-6.31 t/ha obtained at the Study Station (Seram et al., 2011; Abidn et al, 2015).

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Generally, maize in Indonesia is cultivated by small scale farmers which profits there from are relatively low. As a result farmers earn a relatively low income from the crop production (Ibrahim, 2011). In addition to the low productivity, the low profit is largely caused by the hugeproduction costs that farmers deal with. One of the largest production costs in corn farming is the cost of inorganic fertilizer (Rahmawati, 2012). In addition, the constant use of excessive inorganic fertilizers without any use of organic fertilizers has given rise to declining fertility of the soil and reduced immunization of plants, which ultimately results in the low yield of maize and the incremental use and cost of drugs (Bara and Chozin,2009; and Maruapey, 2011).

Therefore, a viable solution to step up the maize productivity as well as the income of maize farmers as an alternative is through the utilization of animal manure technology. Animal manure is easy to prepare and use as the raw materials are accessible, for maize farmers do a moonlighting by breeding livestock as an additional source of family income. Keeping livestock is intended to be merely sold while other potential by products are neglected such as the dungs which are wasted away that means the animal manure is not fully capitalized on by maize farmers. Animal manure is an inexpensive fertilizer whose appropriation contributes to significant rise in the maize production, improved soil fertility, and increased agro-ecological security of maize farming. (Ridwan dan Zubaidah, 2011; Rahmawati, 2012; Tasie et al., 2016).

In spite of the facts, several studies have identified and investigated factors that lead to low usage of animal manure on maize farming (such as Akudugu et al., 2012; Rahmat., 2014; Gelgo et al., 2016; Nyengere., 2017), however, the driving and inhibiting factors of the farmers' attitude in using animal manure are not yet fully understood and empirically examined. Warren, (2004) and Swinton, et al. (2015) suggested the importance of the inhibiting and driving factors paradigm to elucidate farmer behaviours in the use of an innovation / technology because of the complexity of the farmers' behaviour in the use of an innovation / technology and the influential picture of the driving and inhibiting factors influences. Therefore, this research is expected to fill the literature gap by providing empirical information about the factors driving and inhibiting the behaviour of farmers in the use of manure in the maize farming in Indonesia.

Review of Literature

The adoption and usage of innovation or technology hinge on the farmers' behaviours (Chand et al., 2011). Several theories in literature seek to explain the farmers' behaviour. All of themes hare such common elements as attitude and intention which lead to the emergence of certain behaviours. Amongst the theories of behaviour, Ajzen's theory of planned behaviour (TPB) (1985) has provided a beneficial framework for understanding farmers' behaviour. TPB suggests that the more positive the attitudes, norms of subjects and behaviour control are the more likely one wants to behave in a certain way whenever he sees a chance. Hattam (2006) argues that farmers' attitude negatively and insignificantly influences the usage of an innovation/technology that a mere attitude does not sufficiently encourage farmers to use it. The perceived social pressure (subjective norms) and ease (felt behaviour control) that form the intentions are deemed more important. Both impose a positive and significant effect on the formation of intention to use it. According to Greenley (2014) attitude, subjective norms and behavioural control of TPBs do not always serve as a driving factor but they can also hinder the use of an innovation/technology. In addition, according to Pike (2008) change in farmers' behaviour in utilizing innovation or technology is greatly influenced by internal and external factors. The synergy of both factors influences the behavioural component (attitude, subjective norms and behavioural control).

According to Willock et al. (1999); and Burton (2004) previous studies on the farmers' behaviour in adopting an innovation/technology employed theory of planned behaviours. Although it is necessary, the behavioural theory alone inadequately provides a sound basis for studying farmer behaviour in adopting or using technology when it is not integrated with other theories such as Rogers' (2003) the adoption of agricultural innovation theory and Davis' (1989) Technology Acceptance Model (TAM). According to Rogers' (1983) Innovation Diffusion theory prior to farmers' adopting an innovation or technology, it is of a necessity to consider the attributes/characteristics of the technology first.

Hence, before endorsing an agricultural innovation or technology for an adoption, the attributes/characteristics of the technology should then be evaluated. There are five attributes of an innovation/technology. The first attribute, relative advantage, shows the degree to which an innovation/technology affords more benefits than previous innovations/technologies. These benefits can be

viewed from a technical stance, economy, prestige, user-friendliness, and satisfaction. If farmers feel that an innovation or technology offers a relative advantage they will adopt it. The second attribute, compatibity is the compliance of an innovation/technology with the self-worth, experience, and needs of the farmer. The third attribute, complexity which refers to level of difficulty of an innovation or technology to understand and use.

The more complex and intricate an innovation/technology is the harder it will be for farmers to adopt. The fourth attribute, the trial ability is the extent to which an innovation/technology can be tried out and tested. The last attribute is observability related to the extent to which the outcome resulted from the adoption of an innovation/technology can be observed and communicated. If an innovation/technology can be tried out before the adoption it will shore up the farmer's desire to adopt it. The theory of technology adoption previously proposed aims to find out why and wherefores one adopts a technology and does not seek to explain a series of cause-and-effects as regards one's act of adopting technology. Davis 'theory of TAM sets forth several factors which influence farmers' behaviour in accepting and using a technology. According to the theory of TAM, one's attitude toward a technology is explicable by the perceived benefit and simplicity that acceptance and usage of a technology can be sequentially and reciprocally explained.

In the context of utilizing animal manure technology, Lory and Masseye (2013) argued that the use of manure is made hard by nutritional imbalances therein, the diversity of fertilizer sources, difficulty in estimating nutrient availability, and relatively low nutrient concentrations limiting the profitable transport distance. Additionally, the use of manure also can lead to the growth of weeds on the soil that can reduce yields by 20% to 80%. According to Wait haka et al (2007), the main hindrances of using animal manure can be put into external and internal factors. External factors comprise rainfall (e.g. higher than 700 mm rainfall per year); access to irrigation; infrastructure that slashes transport costs; credit, because costs are associated with the purchase, storage and transport of a bulk of fertilizers; and the critical period of commercial farming which elevates the economic scale in trading fertilizers. Internal factors include the cash availability and access to credit, access to input and output market and complementary inputs which may have 'thin' 'markets (such as livestock manure), and proper knowledge. The results of previous studies identified the factors that influence maize farmers in using fertilizers.

Tasie et al. (2017) found that the low marginal physical product and the high cost of transport lowers the profitability of the animal manure use in the maize farming. Yanggen et al. (1998) found that the use of animal manure is determined by human capitals (education, extension, and health); financial capital (income, credit and assets); infrastructure services (infrastructure, quality control and contractual reinforcement, governmental info's and policies); crop yield responses (biophysics, environment, technology, and extension), input and output prices (behavioural structures and subsector performance, and competition).

Gelgo et al (2016) evaluated factors affecting farmers in making decisions concerning the use of animal manure. The results showed that the number of household members and farm income negatively influenced the farmers in deciding to use manure, while the number of livestock, contact with extension workers, access to information media and being a member of farmers' group are positive influential factors on farmer's decision. Nyengere (2017) identified socio-economy variables that affected decision making to adopt and use animal manures and the results showed that education, total yearly income, and the size of households influence the use of animal manure. Makokha et al. (2001) identified socio-economy factors which influenced the use of animal manure and inorganic fertilizers and found that the usage of inorganic fertilizers and manure is significantly affected by extension, membership in an organization, the size of household, hired workers to apply animal manure, the possession of livestock, and non-farm employment income.

Ali et al. (2009) examined factors diminishing the adoption of animal manure and found that they include high non-farm employment income, solid manure compared to slurry and the number of livestock per hectare. Whereas the factors that elevate the adoption of manure comprise the transport distance, contractual agreement for fertilizer payment, and thoughts concerning the benefit of fertilizer testing. Ebewore dan Emaziye (2016) examined the use of animal manure and the results showed that farmers mostly did not use manure because livestock manure is not available and they prefer to use inorganic fertilizers and bulk manure instead. The results of logistic regression showed that three variables in terms of the animal manure use encompass the education level, the vastness of land, and farming experience.

Mugwe et al. (2007) investigated the determinants of the adoption and use of animal manure. The results showed that the use of manure has a positive relationship with employment, farming

experience, perceptions of soil fertility, external aid, non-farm employment income, farming income, perceptions of food and financial security, the number of livestock possessed, and the size of the household. Beckman and Livingston (2012) examined the discrepancy in costs and benefits associated with the use and non-use of manure on the maize farming, and found that the use of manure lowered operational costs due to reduced fertilizers and land-clearing costs. However, the use of manure causes the dwindling yields and using or not using manure does not make any difference. Likewise, limited use of an organic fertilizer does not realyly affect costs or benefits conferred.

Material and Methods

This study was conducted in the span of 6 months in the province of South Sulawesi which is one of the maize production centers in Indonesia, starting on May through November 2017. Systematic sampling method was selected for the purpose.The regency was chosen on the basis of the vastness of the harvested area in every regional sector in South Sulawesi namely, the west sector which is Jeneponto regency with the harvested area of 47,663 hectares and production of 201,446 tons, and the east sector which is the regency of Bone with the harvested area of 43,606hectares and production of 148,293 tons. Out of the two maize production centers regency, three sub-districts with vast harvested area and most livestock were selected. Subsequently, 3 villages were chosen from each sub-district the potential site for the animal manure development. Furthermore, from each village 8 maize farmers were randomly selected that the total number thereof was 144 farmers.

The study was designed using a quantitative approach through field survey methods. The primary data collection was conducted through interview and observation. The interview was carried out by paying visits to farmers in the maize farm to obtain pictures and information on the manure use in the maize farm. Interviews were structured by asking questions and engaging the farmers as respondents in discussion using the previously planned questionnaires. The purpose of having direct interviews with the farmers was to help the farmers that cannot write to fill out the questionnaires while getting additional information that is not included in the questionnaire.

In this study the questionnaire presents a list of questions in the form of multiple choice questions and open-ended questions on behaviours, attitudes, subjective norm, and behavioural controls set forth in TPB. Behaviours in using manure are defined as the actual behaviour demonstrated by individual farmers in the use of manure which are gauged using 1 item: the practice using manure in the maize farm in the past year. The item-based data used 3 point Likert scale that is, 1 (never practices), 2 (occasionally practices) and 3 (always practices) applying manure to the maize farm. Furthermore, the attitude is defined as the individual farmer's perception as a respondent of using the manure. Subjective norm is defined as the individual farmer's perception of the expectation of the people influencing their lives in respect to the use of manure in the maize farm. And, behavioural control is defined as the individual farmer's perception of his ability in using animal manure.

TPB has short comings as its structure (attitude, subjective norm, and behaviour control) is hard and is deemed by farmers as hard to. Therefore, to deal with the issue this study uses other theoretical constructs as suggested by Greenley (2014) namely, (1) Roger's Diffusion of Innovations theory (DoI) (2003)which sets forth characteristics of animal manure technology such as relative advantage, compatibility, complexity, trialabilty, and observability and (2) Davis' TAM theory (1989) which elucidates the benefits and simplicity in using animal manure technology. Based on the two theoretical constructs, attitudes are measured by 8 items: (a) relative advantage which is an individual farmer's perception of profits he gains from using animal manure (elevated maize productivity and reduced production costs) instead of inorganic fertilizers; (b) flexibility which is an individual farmer's perception of flexible use of manure opposed to inorganic fertilizer; (c) observability which is an individual farmer's perception of the communicability of the outcome of the manure use; (d) the reliability which is an individual farmer's perception of the potential use of animal manure on the maize farm; (e) complexity which is an individual perception of how complex is the use of manure compared to that of inorganic fertilizers; (f) environmental pollution regarding individual farmer's perception of animal manure as environmental pollutants; (g) the use of manure as fertilizer relates to individual farmer's perception of usefulness of manure as fertilizer to improve/elevate soil fertility.

The subjective norm is measured by 5 items: (a) the role/encouragement of the community leader which relates to the individual farmer's perception of the community leaders' supportive encouragement in the use of animal manure; (b) the role of government which relates to an individual farmer's perception of the support from the government to endorse the use of animal manure; (c) the

role of information media which relates to an individual farmer's perception of the media support to encourage the use of animal manure media; (d) the role of family which relates to an individual farmer's perception of family support to encourage the use of animal manure; and (e) the role of other farmers which relates to an individual perception of support from other farmers to encourage the use of animal manure; Behavioural control was measured by 10 items: (a) the role of family which relates toan individual farmer's perception of time needed for the use of manure rather than inorganic fertilizers; (b) tri ability which relates toan individual farmer's perception of trying manure out before the actual use; (c) compatibility which relates toan individual farmer's perception of the appropriate use of manure in compliance with the values and needs farmers have; (d) initial experience which relates to an individual farmer's perception of the level of satisfaction/the fulfilment of expectations after using the manure; (e) risk, regarding an individual farmer's perception of crop risks and yields from the use of manure compared to those of inorganic fertilizers; (f) availability of labour which relates to an individual farmer's perception of the availability of the family work in using the manure; (g) availability of livestock manure which relates to an individual farmer's perception of livestock manure to be used; (h) knowledge and skills which relates to an individual farmer's perception of knowledge and skills to use the manure; and (i) market availability, which relates to an individual farmer's perception of access to manure market. The overall data of attitude items, subjective norms, and behaviour control used 3point Likert scale namely, 1 (disagree), 2 (doubt), and 3 (agree).

Prior to using the questionnaire in this study, it was tried out to ensure the internal consistency (reliability) of the variables of maize farmers' behavior in using the manure. The reliability of the variables were calculated using the Cronbach's alpha. Nunnally (1969) argued that a variable in the questionnaire is said to be reliable if it shows a Cronbach Alpha coefficient graeter than 0.60. The analysis of the data was conducted using Non-parametric Spearman correlation test was used as follows:

$$\rho = 1 - \frac{6\sum b_i^2}{n(n^2-1)}$$

Description: ρ = Correlation rank spearman, b^2_i = difference between X and Y, and n = the number of samples taken

Behaviour factors that drive and inhibit farmers from using animal manure are identified by calculating the value of correlation coefficient between the construct of behaviours and the manure use. A markedly positive coefficient indicates positive correlation or means being a driving force contributing to the use of manure whereas, the markedly negative coefficient shows a negative correlation or signifies a behaviour factor inhibiting farmers from using the manure. In this study, there are two variables, namely the independent variable and the dependent variable (control). Independent variables are the driving and inhibiting factors of TPB (attitude, subjective norm, and behaviour control), whereas, the dependent variable is extent of the animal manure used by farmers in the maize farming. The analysis of data used SPSS.

Results and Discussion

Reliability Analysis

The result of reliability of the questionnaire calculated using Cronbach's alpha for farmers' behaviour is 0.625 (reliable) through 0.814 (very reliable). Thus, variable in questionnaire showed internal consistency. The variable of extent of animal manure used does not need internal consistency test because this is represented by one question only.

Driving and Inhibiting Factors of Farmers' Behaviours

The analysis results of the Rank Spearman correlation on inhibiting and driving factors of farmers' behaviour (attitude, subjective norm, and behaviour control) in using animal manure can be seen in Table 1.

Table 1 reveals that attitudes that serve as the driving factors of the farmers' behaviour in manure utilization is the relative advantage (+0.519), flexibility (+0,142), perception of animal manures as environmental pollutants (+0,309), and perception of manure as a source of fertilizers (+0,311) whereas the inhibiting factors encompass productivity (-0.231), observability (-0.198), reliability (-0.213), and complexity (-0.226). Furthermore, the spearman coefficient value showed that the driving factors which have strong relationship with the extent of manure used comprise relative advantage, perception of animal manure as environmental pollutants, and perception of animal manures as a source of fertilizer ($P < 0.01$).

Behaviour	Correlation coefficient	p-value
Attitude		
Productivity	-0,231**	0.005
Relative profit	+0.519**	0.000
Flexibility	+0,142ns	0.023
Observability	-0,198^	0.018
Reliability	-0,.213**	0.011
Complexity	.-0,226**	0.007
Animal manure pollutant	+0,309**	0.000
kotoran ternak sumber pupuik	+0,311**	0.000
Subjective norm		
The role of community figures	+0,143ns	0.055
The role of government	+0,219**	0.009
The role of media	+0,211*	0.012
The role of family	+0,149ns	0.076
The role of farmers	+0.185*	0.028
Behaviour control		
Time	-.0,245**	0.003
Habit	-.0,180*	0.032
Trial ability	+ 0,198*	0.018
Compatibility	-0,139ns	0.055
Initial experience	.-0,283**	0.001
Risk	. -0,234**	0.005
Availability of labour forces	. -0,193*	0.021
Availability of livestock manure	-.0,256**	0.002
Access to manure market	-.0,181*	0.031

Table 1: *Analysis Results of The Rank Spearman Correlation on Inhibiting and Driving Factors of Farmers' Behaviors in Using Animal Manure.*

The results of this study are in line with the finding of Makokha et al (2001) which reveals that farmers utilize manure to reduce cost of fertilizers, improve soil fertility, and decrease environmental pollution. Meanwhile, the inhibiting factors which have a strong relationship with the extent of manure use encompass productivity (p <0.005), observability (p <0.018), reliability (.p <0.011) and complexity (p <0.007). These results are consistent with the findings of Beckman and Livingston's study (2012) that farmers are reluctant to use manure because it lowers the maize production, the nutrients contained are diverse, the complicate use of manure requires good management, and the results are not immediately tangible. Greenley (2014) found that the attitudes that promote the adoption and utilization of technology include the ones toward the relative advantages of technology, better reliability or dependability than the existing technologies, the ability of technology to generate observable benefits, convenience and flexibility of technology used, the productivity of the technology, while the attitudes that inhibit are associated with the complexity and low quality of technology.

The subjective norm as a whole is the factor that encourages farmers' behaviour in terms of manure utilization indicated by positive spearman correlation coefficient, but the subjective norm factors which have strong relationship comprise the role of government (p <.009), the role of media (p <012), and the role of other farmers (p <028). These results are in line with Greenley's (2014) finding that identified subgroup norm factors that play a major part in the adoption and utilization of technology and discovered that the role of media, government, friends and colleagues is a key factor in the adoption of a technology.

Behavioural control which motivates farmers to use manure is trial ability (0.198), while the inhibiting factor is time (-.0.245), habit (-.0.180), compatibility (-0.139), initial experience (-0. 283), risk (-0.234), the availability of labour (-0.193), availability of livestock manure (-.0.256), and access to manure market (-.0.181). Furthermore, trial ability is a driving factor that has a strong relationship with the extent of manure use, while inhibiting factors with strong relationship are time (p <0.003), habits (p <0.032), initial experience (p <0.001), risk (p < 0, 005), labour availability (p <0. 001), availability of livestock manure (p <0. 031), and access to manure market (p <0. .31).

The results of this study are consistent with the findings of Makokha et al (2001) that farmers do not apply manure to maize production because of the deficiency of livestock and capital, the high demand of labours, the unavailability of manure on the market, and manure management complexity. Vanclay (1992) identified some hindrances that farmers confront in adopting new technologies, namely: complexity, risk and uncertainty, and experience of disillusionment in terms of the use of technology. Greenley (2014) found that behaviour control factors that boost the adoption and utilization of technology encompass initial experiences in the use of technology, and that inhibiting factor is the complexity of the use of technology.

Conclusion and Implication

This study showed that the manure was applied to maize farm to the medium to the high extent that it affords opportunity to elevate it to a greater extent. In addition, farmers' attitudes are factors considered to be inhibiting the use of manure comprising attitude toward productivity, observability, reliability, and complexity; factors that facilitate encompass attitudes toward relative advantage, the perception that livestock manure are environmental pollutants, and the perception that manure is a source of fertilizers. In terms of subjective norm factors considered to drive are the role of government, media, and other farmers. Behaviour control includes the inhibiting factors such as time, habit, initial experience, risks, labour availability, the livestock manure availability, and access to manure market; whereas, trial ability is facilitative.

This study has theoretical and practical implications. In terms of theory, this study integrates Ajzen's TPB theory (1985), Rogers's Diffusion of Innovations (DoI) theory (2003), and Davis' TAM theory (1989). The interation of those theories provide a more comprehensive framework for the farmer behaviour assessment in terms of adopting an innovation / technology. This study serves to fill the gap on farmers' behavior in the previous studies which do not shed light on the driving and inhibiting factors in farmers' adopting innovation / technology. Practically speaking, this study can help policy makers and maize farmers in setting up strategies / program for it is easily applied by evolving the driving factor and minimizing the inhibiting factors that hinder farmers from using manure. Development of driving factors is made possible by the active role of government, mass media and farmer groups to promote the benefits of using manure such as increasing maize production, slashing production costs, and improving soil fertility. Whereas, to lessen the inhibiting factors can be achieved by increasing demonstration plots; providing livestock assistance, fertilizer package subsidy (inorganic and manure fertilizer), offering easy access to credit facilities and technology, increasing the use of manure in maize farm, offering socio-economic implication by enhancing household incomes and agro-ecological security.

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Conflict of Interest

The authors declare there is no conflict of interest in ffinancial, academic, commercial, political or personal.

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