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The need for ICT education for managers or agri-businessmen for increasing farm income: Study of factor influences on computer adoption in East Java farm agribusiness

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ABSTRACT

In the present era of globalization ICT plays a vital role to make a produce competitive in global market via all ICT manifestation, such as audio and video, computer and internet technologies. ICT subject has to be taught in tertiary education including students at agriculture colleges. When graduated students become farmers, they may become successful managers. A research has been done in East Java. The sample comprised 178 managers/agribusinessman. The aim of the research was to investigate the factor influences on computer adoption in East Java On-Farm Agribusiness (EJOFA) and the implications on sustainable agricultural development. The research was conducted in EJOFA with the target population being farm agribusiness owner managers. The data was collected using multi stage sampling method and a combination of mail and semi structured interviews. The qualitative data on sample characteristics and variable instrumentation were analyzed using cross tabulation.

Three main hypotheses have been tested, namely, H1: business area influence computer adoption, H2: a large company sized influence computer adoption, and H3: gross sales influence computer adoption.

To test the hypotheses, logistic regression had been employed. The results of analysis showed that those three hypotheses are accepted. These can be meant as follows: The research produced some research findings; (i). Business area have influenced computer adoption; (ii) The probability on adopting computer for agribusiness has strongest influenced by manager's ages 41+, education (TAFE and over), and gross sales, (III) The computer mostly has been used for administration purposes.

These findings indicate that providing computers and other ICTs for managers or agribusiness-man is important. Considering that most progressive managers or business-man are young graduates from tertiary education, therefore, it is suggested that the additional subject on ICTs Education is a must. The final main objective is, of course, increasing farm income.

Keywords: agribusiness, ICT-computer, multi-stages sampling, logistic regression, East Java

BACKGROUND

Agribusiness sector has had a significant role in national development directly such as to contribute to the Gross Domestic Product (GDP), employment generation, people's income, poverty alleviation, foreign exchange earnings through export, and national food security, and indirectly i.e. to create conducive environment in implementing national development as well as inter-sector synergy relationship.

Within the context of agricultural sector, during the 1970s and 1980s, this sector showed a positive trend. The growth of Agricultural GDP averagely 3.2% per year, and rice self-sufficiency has been successfully achieved in 1984. This was a remarkable success, since previously,

Indonesia was one of the largest importer countries in the world. Presently in 2006 the growth still remains around 3.5% per year.

In east Java in which this research was conducted, is one of agricultural base areas. East Java's agricultural business growth has become concern since the formation of economic independency of the provincial government. Accordingly, there are some strong agro industries in East Java such as: tobacco, sugar, fisheries, fruit and agro tourism. For example, East Java is one of the provinces that supply the largest quantity of fruits to the Indonesian fruit markets such as mango, orange, papaya, banana and pineapple. In 1999, this province produced 1,402,322 tons of fruit from 10,523,336 tons or 13.326% of national stock (MOA, 2001). Those fruits are mainly planted in rural areas in all of the districts and are managed traditionally by farmers.

In relation to the regional economy (Otonomi Daerah), it is important for East Java to improve regional economic growth on agricultural based business. It can be done through the improvement of the agricultural industry through out adopting very current technology effectively. The agribusiness productivity theoretically is influenced by many factors such as labor, capital and technology. The sophisticated of the technology especially computer technology in some countries derives widespread application by farmers such as book keeping, planning capital expenditures, pest control, pricing strategies and internet possibility are the benefits of computerized adoption in agriculture.

The computer technology adoption as part of off-farm agricultural mechanization expected to play a significant role on designing strategic plan, market design and quality control for agricultural industry to meet ISO qualification. The global market and ISO qualification inquiry refers to the value of agricultural product which can meet customer specification (FAO, 2001). The value creation by adopting ICT is also one of the enquiry of Indonesian agricultural priority development (MOA, 2003).

Even though it is found that there is a growing interest of computer for agriculture development, inconsistency of IT deployment across regions also creates constraints within an increasingly integrated global industry. As responsiveness and speed of business are critical to the success of e-agriculture, any technical constraints are impediments to the growth of the industry. At the same time, farmers have been somewhat slower to adopt computer and Internet technology than the average American. Some of this is related to place. Some is related to age (older individuals adopt computing more slowly) and personality traits that resist spending additional time inside doing record keeping.

Unfortunately the study related e-Agriculture or e-Agribusiness is rarely studied. The study of factors influences on the use of computer in all farmers' level an all sectors will guide the development program. The race majority of EJOFA farmers are East-Javanese and Maduranese has an open-minded culture with impact on positive response on new technology.

As EJOFA becomes a barometer of IT research, therefore, the study thus focused on the EJA computer adoption and its determinant factors. Data from EJOFA has been used to estimate probability model of computer adoption by farm level and agribusiness area. The conclusion of the research will be considered as an implication for other regions in Indonesia.

PROBLEM IDENTIFICATION AND RESEARCH QUESTION

Presently, the Indonesian government, under the Ministry of Agriculture (MOA) has been embracing many parties on increasing agribusiness productivity by mechanization and technology sophistication diffusion. By the system definition, agribusiness can be defined as either on-farm agribusiness (agro industry; horticulture, fisheries, crops and livestock) or off-farm agribusiness such as food processing, farm tools producers, seed producer and many others which is related with agricultural product.

The mechanization technology including on-field technology (tractor, breeding and harvesting machinery) and off-field technology like Computer Aided Development (CAD) and management have the aim to improve output value. To succeed that plan, it is important to study what factors potentially supports and being roadblock. This research is concerned with studying the common factor influences such as cultural and demographic characteristics on computer adoption.

The cultural and demographic characteristics of East Java's farmers which are commonly known as an open-minded (extrovert/explicit) reflected on the existence of some agricultural associations and cooperative agribusiness. It would be potentially either positive or negative responses towards any technology adoption including ICT-computer. The demographic characteristic of EJOFA is of concern as influencer factors, hence, the research also would like to answer the question of what factors influence ICT-computer adoption?

THE REVIEW OF LITERATURE

Study on e-Agriculture and/or e-Agribusiness is rarely done in Indonesia. Soekartawi (2007), in his article 'e-Agribusiness: Theory and Its Practice' discuss the issues of e-Agribusiness in Indonesia. He argued that many of the issues faced by e-Agribusinesses are the same as those firms in other sectors. However, there are several critical differences. Characteristics of the agricultural sector and its participants may offer some inherent impediments to the implementation of E-Business practices. Resistance to changing business practices, tradition, and lack of familiarity with IT may be more of an issue in agricultural sectors. Likewise management traditions may make the idea of rapid development and deployment of new business models and strategies harder for agricultural firms than for businesses in other industries. Place, industry structure and participant demographics are also constraining factors. All these raise additional questions for discussion.

Some scholar doing research on computer adoption has mentioned that different areas of agriculture have different preference on adopting computer technology. For example the research that has been done by Putler and Zilberman (2001) in Tulare County California, show that livestock producers much more likely to use computer for production decision rather than crop producers. A similar research has been done by Ernst and Tucker (2002) with the findings saying that larger farms tend to adopt both ICT more rapidly than smaller farms. Batte (2005) on his study mentioned that livestock has less hour on using the computer. On the other hand, Gloy and Akridge, (2001) in particular analysis of computer adoption has findings that in large US farms, the type of the companies did not influence significantly on computer adoption but the gross sales does. The phenomenon possibly has similarities with EJA which in the agriculture business has diversity such as food crops, tree crops, livestock, and fisheries has never been investigated on using ICT-computer for business.

H1: business area influence computer adoption

H2: a large company sized influence computer adoption

H3: gross sales influence computer adoption

It is realized that there are many aspects that influence ICT knowledge through computer adoption. These are surely covered in this research. However they are reported all here due to limited pages allowed by conference organizer.

METHODOLOGY

This research was conducted based on an explanatory research design. Explanatory research can be defined as a method or style of research in which the principal objective is to know and understand the trait and mechanisms of the relationship and association between the independent and dependent variable. In explanatory research, investigators attempt to test the hypothesis based on some previous study. The concern of the study was to identify what is the most significant factors on decision making process of ICT-computer adoption and in what extent farmers use computer for value creation given in the research questions. Since the outcome variable was dichotomous, the binary logistic regression model was used.

Sampling frame and sampled population

Respondents of the study were one hundred and seventy eight on-farm agribusiness (agro industry) owner managers from 4 agricultural areas (horticulture, fisheries, livestock and crops) in East Java province. There are 29 counties and 8 municipalities, and 2 administrative cities.

From those 39 regions, researcher use multi stages sampling method to minimize costs. The first stage, we chose two groups -in which three big universities are settled in- among four groups based on East Java's economic development planning. According to East Java Economic Development Plan, the regions divided into four areas as the first stage sampling frame;

- North-South Bank (*Koridor Utara Selatan*) includes Gresik, Surabaya, Sidoarjo, Mojokerto, Pasuruan, Malang, Blitar.
- Nort-West Bank (*Koridor Barat Daya*) includes Jombang, Kediri, Tulungagung, Trenggalek, Nganjuk, Madiun, Ponorogo, Pacitan, Magetan.
- East Bank (*Koridor Timur*); Probolinggo, Situbondo, Bondowoso, Lumajang, Jember, Banyuwangi.
- North Bank (*Koridor Utara*); Lamongan, Tuban, Bojonegoro, Ngawi, Bangkalan, Sampang, Pamekasan, Sumenep.

Table 1 shows the distribution of the response among four counties of EJOFA. The total sample population is 178 out of 314 (56.69%) from the research population with the distribution such as follows; Banyuwangi 38 responses out of 98 (38.76%), Jember 57 out of 84 (67.86%), Malang 52 out of 76 (68.42%) and Sidoarjo 31 out of 56 (55.36%).

Most responses represent all sizes of business by types and only some of them like livestock in some counties do not have large companies. Two big responses are from Jember and Banyuwangi in which those two areas are very close to the base point of the interviewers so that it is closest to the centre of coordination and that is the most accessible area.

***Table 1**. The Valid Response distribution of the Sampled Population per types of business in selected EJOVA*

		Address				Total
		Jember	Banyuwangi	Malang	Sidoarjo	
Horticulture	Count	20	11	16	9	56
	% within type of business	35.7%	19.6%	28.6%	16.1%	100.0%
Fisheries	Count	18	13	19	16	66
	% within type of business	27.3%	19.7%	28.8%	24.2%	100.0%
Lifestock	Count	12	7	11	2	32
	% within type of business	37.5%	21.9%	34.4%	6.3%	100.0%
Crops	Count	7	7	6	4	24
	% within type of business	29.2%	29.2%	25.0%	16.7%	100.0%
Total	Count	57	38	52	31	178
	% within type of business	32.0%	21.3%	29.2%	17.4%	100.0%

Data Collection and Analysis

This research was conducted in between July and October 2006 in East Java. The questionnaire were developed by the researchers and distributed to the agricultural managers one by one. Some pilot survey has been done to test the questionnaire. Using combined methods; mailed and semi structure interview the research had been done in order to get a high responses. Ten trained final-year students were employed under tight supervision attached in the area to get the primary data. Students knock the door one by one and made an appointment first with owner/manager. When the respondent did not have time to be interviewed, let the owner manager fill in the questionnaire on their free time. The instruction to do that is clearly explained on each section of the questionnaire. After some days, the students pick the questionnaire up from the owner manager. This technique counted for sixty five percent of the total responses. The rest (35%) had been investigated by the interviewers by asking to the managers whether they have time to be interviewed. When they were ready, the interviewer then asked them to response to the questions.

The Questionnaire

Using combination between open and close question, the questionnaire was divided into four sections; (1) the organizational cultures, (2) demographic of owner managers, (3) company's profile. The first three sections are the qualitative information about managerial and organizational characteristics. That information will be used to investigate the influence factors on deciding whether EJOA adopt computer or not adopted. All of those instruments will be explained later in this paper.

DATA ANALYSIS

Logistic Regression Model

Logistic regression (*Logit*) is a statistical tool which produces prediction equation. *Logit* realize one to predict discrete outcome which mostly dichotomous as a dependent variable and set of various types of independent variables, such as continuous, discrete, dichotomous, taking on two or more possible values (Hosmer and Lemeshow, 1989, p.1).

Logit is part of statistical models namely Generalized Linear Models (GLM) which includes ordinary least square (OLS) regression, ANOVA, and multivariate statistics such as ANCOVA and logistic regression indeed. However, logit is still different with Ordinary Least Square regression (OLS) in the choice of parametric model and the assumptions. In particular assumption, OLS data inquiry should be normally distributed and limited type of variables either independent or dependent one. The OLS needs either an ordinary or nominally dependent variable, while in logit the dependent variable normally is dichotomous and the dependent variable could be categorical, nominal and ordinal. Although OLS regression estimation is unbiased, the estimation is not efficient. The OLS has also problematic because the assumptions of OLS are violated when using a binary response variable. Therefore, in deciding whether the researcher will use either OLS or Logit is depending on the expected outcomes. The 0/1 outcome is turned into the grouping variable while in OLS a former predictors are turned into outcome variables.

The research that has been done by Pohlmann, (2003) had a conclusion whether both models can be used to test the relationship with a binary criterion, but logistic regression is superior to OLS on predicting the probability of attribute. He then recommended that logistic regression should be the model of choice for binary dependent regression analysis.

There are two types of simultaneous equations to control to the interrelationships between dependent variables in addition to single-equation i.e. ordinary least squares (OLS) and logistic regression models. We use Logit not OLS as its characteristics of the model in which one or more variables are binary (dummy) (Hosmer and Lemeshow, 1989, p.1.; Kmenta, 1971, p. 425). The following model is the Logit equation for the research. The Logistic regression model will be such as follow:

Where *ln* is natural logarithm, *p* is the probability of adopting computer; is constant value,are parameters to be estimated; = is dependent variables on ICT adoption that takes on a value of yes=1 if the respondent or a farmer is computer and no= 0 if not using computer. X*assoc* is the dichotomy variable (1/0) of group membership of the companies, X*family is* dummy (1/0) variable of employees family relationship (<10%), X*literacy* is the scale variable of ICT literacy of the manager's and employees (1= very weak, 5 = very strong), X*involved is binary* (1/0) variable of manager involvement in daily activities, X*gender* is dycothomy variable (1=male, 2= female),

X*age* is dummy variable with reference category age 41 to 50, X*edu* is dummy variable of education of the manager with reference category TAFE, X*types* is four types of business (categorical), X*class* is dummy variable with reference category large business, *Xsaleslog* is log10 of gross sales volume the last semester (continuous), is assumed to be a standard normal.

Expected Output

The out come of this model will be the significant probability how the dependent variables decide to adopt (1) or not adopted (0) in one of the IT level. The explanatory variables will produce the significant probability on influence on adopting ICT. Therefore the logit will test the following hypothesis: *'Accept if 05 with the lowest level of significant 95% '*(Phillip, 2003)

Exploratory data analysis (EDA) was conducted to skew ness, kurtosis and data distribution of continuous variables. A Jarque-Beta test had been done to check the normality for all continuous variables, while categorical variables had been tested using cross-tabulation. Both Pearson correlation and Fisher test produce the significant value which reflects the relationship between ICT-computer and explanatory variables. Neither continuous variables nor categorical data showed that the data were normally distributed and therefore had to be transformed. Before the decision to make a dummy variable, the data re-categorized to produce a better distribution. The reference category then being concern to creates the dummy variables. While the continuous variables then been smoothing using log10.

RESEARCH FINDINGS AND DISCUSSION

Multivariate Analysis

Multivariate analysis statistical technique was used to estimate each explanatory variables and it impacts on the computer adoption. This will examine and provides an overview of the relationship between dependent variable and explanatory variables. Although the literature review discuss the important relationship between computer adoption and demographic manager characteristics, organizational culture and companies characteristics, the multivariate comparison will greatly overstate the significant relationship among them. The multivariate analysis result is presented in table 2.

For example, although there is significant association between the age and computer adoption ($X^2 = .019$, $p = .123$). The term of computer as a Portable Computer (PC) will not so attract young age's manager as a decision maker. This is associated with the research finding of Putler and Zilberman, (2001) and Batte (2003). The computer adoption tends to be accepted on the range of 41-50 (27.9%). The rest are not to adopt computer with the highest percentages on the range of ages 21-40 (92.6%). These situations associated with the highest self motivation on the elder groups to be more precise in numbers by computerized system. On the other hand, the younger group prefer not to adopt computer due to their high mobility as the computer in EJOFA normally had been identified as a Portable Computer (PC).

There was a significant association between ICT-computer and family relationship in EJOVA ($X^2 = 001$). The highest percentage belongs to family relationship of the employee in between 21-30%. Fisher exact test been used in this association test due to one of cell have expected count less than 5 and 95% confidence level. As part of Asian-organizational culture and most of EJOFA are family business therefore it is reasonable that the higher the family relationship among employee has relationship with computer adoption. The rapid development of ICT-computer in Indonesia as well in East Java, due to the; (i) internet traffic in Indonesia increase drastically—

about 2.05 Mbps (1999) to 3,900 Mpbs. It means increase about more than 2 thousands time. (ii) Internet users also increase from 512 thousand users (1998) to 16 million (2005). It means increase 32 times (Setiarso, 2007).

Table 2. *Multivariate Analysis*

Managerial/organizational	ICT-Computer Adoptions			Statistics	
CHARACTERISTICS	**YES**	**NO**	**DF**	**SIG (5%)**	***P* VALUE**
Age 51+	11.1%	88.9%	2	.019*	.123
41-50	27.9%	72.1%		(2 sided Pearson X ²)	
21-40	7.4%	92.6%			
Family relationship	4.2%	95.8%	3	.000*	.000
<10%	23.5%	76.5%		(2 sided Fisher exact test) (a)	
10-20%	41.2%	58.8%			
21-30%	36.1%	63.9%			
31%					
Education:	20.3%	79.7%		.000*	.010
Secondary/college	81.3%	18.8%		(2 sided Fisher exact test) (b)	
TAFE	21.7%	78.3%			
Bachelor	4.4%	95.6%			
Master+					
Gender	15.9%	84.1%		.001*	.000
Male	43.6%	56.4%		(2 sided Fisher exact test) (c)	
Female					
Association membership	18.5%	81.5%	1	.258	.107
Yes	23.9%	76.1%		(1 sided Pearson X ²)	
No					
Class of Business	21.0%	79.0%	2	.019*	.059
Large	30.0%	70%		(1 sided Pearson X ²)	
Medium	3.7%	96.3%			
Small					
Involved	19.3%	80.7%	1	.003*	.002
Yes	63.6%	36.4%		(2 sided Fisher's exact test) (d)	
no					

Sales volume:	Mean = 5,588.1933	Skewness = .222 SE skw =.185
(in million rupiahs)	log10= 2.7666	Kurtosis = -1.329 SE kurtosis = .367
	Median = 401.2500	
	log10= 2.5563	
	Mode = 15,000.00 log10= 4.18	
ICT literacy	Mean = 2.81	Skewness = -.188 SE skw = .183
	Median = 3.00	SE skewness = .183 SE kurtosis =.363
	Mode = 3	

Education level indicated having relationship with the ICT-Computer adoption. TAFE level is the highest probability association. The higher the level of education they were not likely to adopt computer or PC. They prefer to use most sophisticated one such as *Personal Data Assistance (PDA) or mobile phone* which are more stylist. This figure will against Batte (2003) with the research finding that farmers who work in a large farm has a higher education level and tends to use computer due to the higher competition.

An association membership such as agricultural cooperatives field-farmers association is part of organizational culture and being trends in EJOFA. However, this culture did not have any association with ICT-computer adoption. This is Manager's involvement on the field indicated has a significantly association with computer adoption. The figures will also against Batte (2003) research findings that off-farm's farmers tend to use computer because of manager's scare time.

In term of computer usages, farmers were asked to evaluate multiple response questions that was asked to the farmers to find out on the purpose of computer use. Dichotomy group tabulated at value 1. The responses showed that the priority use of computer used was for administration purposes (34.5%). Those figures then were followed by 27.2% i.e. for company report analysis and 24.6% for data base use. The rest 10% is on the use of computer for product design, while 2.8% is missing value (other). The average period of computer use by companies was 1.2 years with standard deviation 0.49.

Logistic Regression Result

There are three situations in the analysis, based line (from Block 0 output), the variables not in the equation interpretation, test of associations, interpretation of the variables in the equation, and model development. Baseline situation is the situation when only the constant is in the equation or model the prediction for the computer adoption without using manager's characteristics, company's profile and organizational characteristics. If we predict that all the farmers would not adopt computer? The last section of four tables is below block 1. They show the results when the three groups predictors are entered simultaneously.

The percentage of correct predictions (80.4%) if all the farmers were predicted to be in the larger (not adopt computer) group. The first variables in the equation table shows that if the farmers predicted that all of them will not adopt computer, the odd of successful prediction would be significantly different from (p=0.00).
The variables not in the equation table shows that seven of the thirteen variables (types of business, gender, literacy, involved, saleslog, dummy age and dummy education are, individually

significant predictors of whether farmers would adopt computer or not. The other four are not significant predictors.

The Omnibus Test of Model Coeficient tables indicates that, when we consider all thirteen predictors together, the model or equation is significant (X^2 = 61.958, df = 12, p = <.001). From the estimating percent of variant accounted for, the "pseudo R^2 indicate that approximately 33% or 53% of the variance in whether or not farmers adopt computer can be predicted from the linear combination of the thirteen variables.

In overall, 88.2% of the participants were predicted correctly. The independent variables/covariates who would not adopt computer were predicted 96.7% correct than at who would adopt computer were predicted 53.3% correct.

From the Variables in the equation table, there are three variables significant in the 90% confidence interval (CI), i.e. TYPES (.090), ASSOC (.096), Literacy (053). While the most commonly significant test is 95% CI, there are saleslog (.004), DM_41 (.039) and DMedu2 (.001). Types of business TYPES_3 was not significant due to fact that (1) SE is quite high relative to B, which make the Wald statistics lower, (2) fact that TYPES_3 is part of categorical variables in which overall TYPES is not significant.

The association membership has level of significant for the CI 90% (.096)

ICT literacy is significant on the 90% CI (.053) and Manager's age has significant influence on computer adoption Manager education significantly influence (p< .001) on managers decision making on adopting computer

The odd ratio and confidence interval of saleslog was .337 means that any one unit improvement on saleslog will improve the probability on computer adoption by – 33.7%. Further, the education level (TAFE) has an odd ratio by 32.256 means that any additional of a Variable(s) entered on step 1: TYPES, ASSOC, SEX, Literacy, INVOLVED, saleslog, DM_41, DM3class, DMEd2, family3.

Table 3. *Logistic Regression Predicting who will Adopt Computer*

Variables	*B*	*SE*	*Odd ratio*	*P*
TYPES				.090
TYPES(1)	1.642	1.175	5.164	.162
TYPES(2)	.160	1.102	1.174	.884
TYPES(3)	-.691	1.406	.501	.623
ASSOC	1.165	.700	3.207	.096
SEX	1.059	.673	2.882	.116
Literacy	1.001	.516	2.722	.053

INVOLVED	-.075	1.426	.927	.958
saleslog	-1.086	.381	.337	.004
DM_41	1.689	.819	5.416	.039
DM3class	-.680	1.189	.507	.567
DMEd2	3.474	1.035	32.256	.001
family3	-.021	.027	.979	.424
Constant	-5.310	2.937	.005	.071

CONCLUSION AND RESEARCH IMPLICATIONS

There are many research results found in this research. The conclusion related to three main hypotheses are: (i). Business area have influenced computer adoption; (ii) The probability on adopting computer for agribusiness has strongest influenced by manager's ages 41+, education (TAFE and over), and gross sales, (III) The computer mostly has been used for administration purposes.

These findings indicate that providing computers and other ICTs for managers or agribusiness-man is important. Considering that most progressive managers or business-man are young graduates tertiary education, there fore, it is suggested the additional subject on ICTs Education is a must. The final main objective is, of course, increasing farm income.

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