Impacts of social and psychological issues on adoption behaviour for agroforestry systems, crop rotation and compost fertiliser in the Northern Ethiopia

Woldegebrial Zeweld[12], Guido Van Huylenbroeck[2], Girmay Tesfay[1], Stijn Speelman[2]

[1] Department of Agricultural and Resource Economics, Mekelle University, Mekelle, Ethiopia

[2] Department of Agricultural Economics, Ghent University, Gent, Belgium

Contribution presented at the XV EAAE Congress, "Towards Sustainable Agri-food Systems: Balancing Between Markets and Society"

August 29th – September 1st, 2017

Parma, Italy

Abstract

This paper investigates how socio-psychological issues affect farmers' decisions to adopt sustainable farming practices using a cross-sectional data from 350 farmers. The data are analysed by multivariate probit and ordered probit models. We find that the probability to adopt sustainable farming practices is affected by education, risk attitudes, information, intentions, social capital and attitudes. The intensity to adopt two and more farming practices jointly is influenced by labour supply, education, livestock ownership, information, risk attitudes, social capital, attitudes, intentions and perceived resource, implying education, social capital, attitudes, risk attitudes and information affect both the probability and the intensity of adoption decisions. Thus, the focus should be given to social and psychological factors to stimulate farmers in dryland and water stressed areas to adopt various sustainable agricultural practices.

Keyword: *Information, attitudes, risk behaviour, sustainable practice, multivariate analysis.*

1. Introduction and Justification of the study

Because of its significant contribution to the overall economy, the low productivity of the agricultural sector has retarded the growth of other sectors. In Ethiopia for example, about 85% of the population depends on agriculture for their livelihoods. The sector also constitutes for about 90% of the foreign exchange earnings and about 43% of the gross domestic product (National Planning Commission, 2015). Growth in the agricultural sector determines the fate of other sectors and also accelerates the growth of the overall economy.

A way to improve the productivity of the agricultural sector is to invest in the technological innovations and sustainable practices (Hillbur, 2014). These can furthermore ensure food security and improve livelihoods (Muzari, Gatsi, & Muvhunzi, 2012) while maintaining environmental sustainability (Lichtfouse, 2012; Veisi & Toulabi, 2012). It is documented that raising the productivity of agriculture is a critical step to reduce rural poverty (Wollni, Lee, & Thies, 2010), which implies the importance of technological innovations and sustainable farming practices to raise productivity and bring sustainable development.

However, the adoption and diffusion of technological innovations and sustainable practices in the least developed countries have remained below the expected levels (FAO, 2015; Gumataw, Bijman, Pascucci, & Omta, 2013; Teklewold, Kassie, & Shiferaw, 2013; UNCTAD, 2015; Van Thanh & Yapwattanaphun, 2015; Wollni et al., 2010) because of demographic characteristics, farm size, land tenure, financial resources, plot location, presence of radio or television, technical assistance, government effectiveness, shocks, and access to facilities (FAO, 2015; Gumataw et al., 2013; Kassie, Jaleta, Shiferaw, Mmbando, & Mekuria, 2013; Teklewold et al., 2013), showing farmers' decisions for adoption depend on multiple interrelated economic and noneconomic factors.

Most previous studies have overlooked the importance of attitudes, intentions, normative issues and risk behaviour on adoption decisions. To our knowledge, little attention has been paid to the potential role of alternative information sources in the adoption decisions. Interest to understand how these factors affect adoption decisions is, however, growing because underestimating these issues may not give adequate information about the human decisions and behaviour, justifying further research to address how social and psychological factors affect adoption decisions.

Therefore, this article aims to investigate how socio-psychological factors, such as attitudes, intentions, normative issues, personal efficacy, perceived resource and risk behaviour affect and stimulate smallholder farmers to adopt sustainable agricultural practices.

2. Theoretical and conceptual literature

Considering the utility maximisation behaviour, farmers can adopt improved practices to enhance yields if they are informed about their attributes and performance through information sources, such as television, extension agents, neighbours and friends. We consider them as informed when their level of awareness exceeds a threshold level in which the adoption decisions has become relevant (Adegbola & Gardebroek, 2007). The observed awareness index is given by:

$$W_{im} = \begin{cases} 1 & if \quad W_{im}^{*} = I_{im}^{*}(Y_{im}^{'}) - \bar{\bar{\mathrm{I}}}_{i} = \beta_i Y_{im}^{'} + V_{im} \geq 0 \\ 0 & Otherwise \end{cases} \tag{1}$$

Where W_{im}^{*} is a latent variable that indicates the degree of being aware of the practices, $\mathrm{I}_{im}^{*}(.)$ is a level of information obtained from different sources, $Y_{im}^{'}$ is a vector of variables that affect the awareness level about the farming practices, $\bar{\mathrm{I}}_{im}$ is a threshold level of information, β_i is a vector of parameters to be estimated and V_{im} is a vector of error terms.

Farmers who are aware of the practices can decide to adopt them (or not) by evaluating their expected utility. They will decide to adopt if the expected utility of adopting (U_i^m) exceeds the expected utility of not adopting or using the traditional management practices (U_i^0) (Wollni et al., 2010). Since the expected net utility is unobservable and the adoption decision is observable, the unobservable variable can be expressed by the observed variable and farmers' choice for the practices (adoption decision) is given by:

$$D_{im} = \begin{cases} 1 & if \ D_{im}^{*} = \mathrm{E}(U_i^m - U_i^0) = \alpha X_{im}^{'} + \varepsilon_{im} \geq 0 \\ 0 & Otherwise \end{cases} \tag{2}$$

Where D^*_{im} is a latent variable representing the decision of farmers $'i'$ to adopt agricultural practices $'m'$, which depends on a vector of explanatory variables (X'_{im}) and unobserved characteristics (ε_{im}), which captures errors in optimisation and perception (Greene, 2003).

Adoption of sustainable practices could be interrelated. A separate estimation might lead to (under) overestimation and a joint analysis (multivariate analysis) is used, which lets potential correlation between unobserved disturbances (Teklewold et al., 2013) and allows for possible contemporaneous correlation in the adoption decisions (Greene, 2003). An adoption decision for interdependent sustainable practices has a multivariate structure (Teklewold et al., 2013) and the multivariate probit function can, therefore, be specified as:

$$D_{im} = \alpha_i X'_{im} + \varepsilon_{im}\text{, where } \varepsilon_{im} \sim MVN(0,\Omega) \text{ and } m = A, B, C \tag{3}$$

Where error terms $(\varepsilon_A, \varepsilon_B, \varepsilon_C)$ jointly follow a multivariate normal distribution with zero means and variance normalised to unity, Ω is the symmetric variance-covariance matrix, ρ is the conditional tetrachoric correlation between two different sustainable practices (Greene, 2003).

If we ignore awareness in the adoption decision, our estimation can be subjected to a selection bias. To avoid this, the adoption decision is only relevant for those farmers who are aware of the practices. The corrected adoption decision, i.e., the conditional probability of adoption decisions controlling for heterogeneous information exposure (awareness), which is also known as the corrected multivariate probit or multivariate probit with sample selection, is given by.

$$\begin{aligned} P(D_{im} = 1/W_{im} = 1) &= \mathrm{E}(D_{im}/W^*_{im} > 0) \\ &= \Phi(\alpha_i X'_{im}) + \delta_{V\varepsilon} * \frac{\phi(\mathrm{Y}'_{im}\beta_i)}{\Phi(\mathrm{Y}'_{im}\beta_i)} \end{aligned} \tag{4}$$

This model estimates only the probability of adoption of sustainable practices by defining a cut-off point between adopters and non-adopters but it doesn't show or define the number of practices adopted, for example, some farmers may not adopt any practice while others may adopt some/all packages or practices. To explore factors that influence the adoption of a combination of practices or individual practice, we use an ordered probit model where the dependent variable has become the number of sustainable practices adopted, which is given as follows.

$$P(Y_i = j|X_i) = P(X_i\beta + e_i \le \lambda_j|X_i) = \Phi(\lambda_j - X_i\beta) - \Phi(\lambda_{j-1} - X_i\beta);\ j = 0,1,2,3 \tag{5}$$

Where $\Phi(.)$ is the standard normal cumulative distribution function, β is parameter vector and $\lambda_0 < \lambda_1 < \lambda_2 < \lambda_3$ are unknown threshold parameters to be estimated by maximum likelihood.

3. Research methodology

This study was conducted in a randomly selected six rural villages in the northern Ethiopia. A sample size of 350 was determined following the Yamane (1967) formula, proportional sampling was done in each village and the target farmers were selected from each village using a systematic and simple random sampling methods.

Farmers have implemented various agricultural practices to improve productivity and yields. From the several practices, which are commonly applied in the areas, explained by agricultural extension agents and development practitioners, we randomly selected agroforestry systems, crop rotation with legumes, and organic compost fertiliser to assess the influence of socio-psychological factors on farmers' choice of interrelated sustainable farming practices.

Cross-sectional data was collected from the sampled farmers using a questionnaire method. A draft questionnaire was evaluated through a preliminary discussion with the agricultural experts and through a pilot survey by ten randomly selected farmers. Based on the reflections from the pre-assessment survey, a structured questionnaire containing parts on agricultural practices, information sources, intention, attitudes, socioeconomic characteristics, and risk behaviour was developed, which was administered by trained data enumerators.

4. Results and discussion

4. 1. Descriptive data and principal component analysis

Many variables of the study are latent, which are measured by and constructed from observed statements. We use a principal component analysis with oblique rotation to reduce the large set of observed statements and identify observed indicators that are loaded to few latent variables with common underlying structure. These statements are responded by five-point Likert scale, for example, strongly disagree, disagree, satisfactory, agree and strongly agree about the issue.

For example, six statements are loaded to intention, including intend to adopt sustainable farming practices in my plots next year; intend to encourage neighbours to engage in sustainable practices; how strong is the intention to adopt sustainable practices in the future; target to use less of biocide inputs, which have adverse environmental impacts; do you think sustainable practices would improve farm productivity and yield; and how likely do you believe that adoption of sustainable practices will increase income and livelihood. These statements have an average loading factor of 0.81, Cronbach's alpha 0.90 and variance extracted 0.72.

Similarly, attitude is loaded and measured by four different statements, such as use of sustainable practices in my plots next year would be a wise idea (very bad - very good); is an important instrument to improve agricultural yield and productivity (very unimportant - very important); is an advantageous to improve fertility of farmland and also biodiversity (very disadvantageous - very advantageous); and is a necessary input to improve income and overall livelihood (very unnecessary - very necessary). These statements are reliable and valid to explain attitudes because they have an average loading factor of 0.84, Cronbach's alpha 0.87 and variance extracted 0.73.

In our dataset, there are 33 risk related statements, which are expected to explain the risk attitude of farmers. Using the principal component analysis, only 22 statements are loaded with five risk factors, such as technology risk, natural hazards, human security, market volatility and financial shocks. We add the values of these statements to construct the value of risk attitude. These statements have adequately explained risk attitudes because they have an average loading factor of 0.79, Cronbach's alpha 0.83, and variance extracted 0.66.

Social capital captures the level of learning and informal communication from social groups, such as friends, families, neighbours, traditional institutions, rural associations and local administrators who can exert pressure on decisions and behaviours. Based on a principal component analysis, five different statements, which shows how farmers' decisions and behaviour are influenced by different social groups and formal rural organisations are loaded to a social capital. These five statements are reliable and valid to explain social capital because they have an average of loading factor 0.81, Cronbach's alpha 0.87 and variance extracted 0.71.

Perceived resource and personal efficacy are other socio-psychological variables, which are loaded by and constructed from three and five statements, respectively. The former variable explains whether the presence of resources and facilities can be an obstacle or facilitator in the adoption of sustainable practices whereas the later shows whether the competence, knowledge, and skills of the farmers presently have enabled them to successfully adopt and operate sustainable farming practices. These statements, which are used to construct these two variables, are reliable and valid because they have an average loading factor, Cronbach's alpha and variance extracted exceeding 0.70.

To construct the value of the latent variable from the respective observed statements, we use the index formula suggested by Tam & Coleman (2011), for example, we summed the values of 22 statements, which are loaded with five risk factors, and divide it by 110 (the maximum possible value) to obtain the value of risk attitude, which ranges, theoretically, from 0.2 (the most risk aversion) to 1.0 (the most risk-seeking behaviour) but practically from 0.39 to 0.86. Since there is no clear threshold in the literature, risk attitude is grouped into three by taking an equal interval as risk aversion (0.39-0.54), risk neutral (0.55-0.70) and risk seeking (0.71-0.86).

Table 1 presents the summary statistics of the variables. Agroforestry systems, compost fertiliser, and crop rotation are response variables. For each practice, farmers were asked a dichotomous question (Yes/No) whether they have applied this farming practice. About 46% of the respondents have adopted agroforestry and 55% compost fertiliser and 59% for crop rotation with legumes. With regard to awareness, we asked respondents their level of awareness or knowledge to sustainable farming practices using five-point Likert scale (very high, high, uncertain, low and very low), which we transformed later into (high, uncertain and low) awareness and about 67% of the respondents have relatively a high or good awareness of these farming practices.

About 80% of the respondents are located in villages, which are found in the temperate agro-ecological zone. The age of the respondents ranged from 30 to 71 years, with a mean age of 48 years and an average farming experience of 23 years. The household size adjusted for adult equivalent was about four persons (labour supply). About 30% of the respondents were found to be risk-averse farmers and about 45% were risk-seeking farmers. About 61% of the respondents have a strong or high intention towards sustainable farming practices.

As can be seen from the same table, about 12% of the respondents have a television, radio or mobile phones and they can use them to obtain information on agriculture, climate and general issues. About 54% of the respondents have frequent contacts with the agricultural officials and agricultural extension workers to get agricultural information and farmers have a good experience of consulting extension workers. Of the respondents, 61% have strong or high social ties and relations with their neighbours, friends, families and other informal social groups.

In Ethiopia, the government has established farmers' training centre in each village, which is more of experimental and participatory instead of traditional training and visit approach, to build the capacities of farmers. To see its effect on adoption, we included technical training, which captures whether farmers have engaged in short-term training, workshop, field days and exposure visits on sustainable agricultural practices. About 39% of respondents have been involved in at least one capacity building activities that focus on sustainable agricultural practices. Thus, practical training accelerates farmers to adopt sustainable practices.

Other socio-psychological variables in this study include attitudes, personal efficacy, and perceived resource, and the mean of attitudes, perceived efficacy, and perceived resource towards sustainable practices is above three points, which justifies that farmers in the study areas have favourable attitudes towards sustainable farming practices. They have satisfactory skills, competence, and experience, which help them to successfully adopt the farming practices. However, resources and facilities can impede them to use these farming practices.

Table 1. Definition and explanation of variables of this study and their respective mean

Variables	Description of the variables	Mean
agroforestry systems	Farming practices like grass strips, commercial trees, shrubs, line fencing, forage trees, windbreaks, and alley farming applied on own plots (0=No, 1=Yes)	0.46
organic compost	The use of compost practices in plot such as weed wastes, leaves, ash, food wastes, crop residuals and other wastes (0=No, 1=Yes)	0.55
crop rotation with legumes	Applied cereal-legume rotational practices on plots for example wheat or barely with bean or pea frequently (0=No, 1=Yes)	0.59
awareness	Level of awareness of farmers on sustainable agricultural practices (1 if farmer has a good awareness of sustainable practices and 0 if not)	0.67
experience	Number of years in farm experience (years)	23.0
labour supply	Number of persons living in the household cell (household size)	4.23
education	Educational level of the head (0=illiterate farmers while 1=literate farmers)	0.46
agroecology	1 if a farmer is from village in the temperate zone and 0 otherwise	0.82
extension service	1 for a farmer that has a frequent contact with agricultural experts and extension workers to get information on agriculture and sustainable practices and 0 if not	0.43
intention	Probability of readiness of farmers to introduce and use different sustainable agricultural practices (1=strong intentions and 0 weak intentions)	0. 61
risk aversion	Smallholder farmers' attitudes towards risks (1 for the farmer who has a risk averse behaviour and 0 otherwise)	0.32
risk-seeking	Smallholder farmers' attitudes towards risks (1 if the farmer has a risk-seeking behaviour and 0 otherwise)	0.45
media influence	Information from television, radio and mobile phone, and influence on behaviour and decisions (1 if the farmer has one of these media appliance and 0 otherwise)	0.12
technical training	1 for a farmer who has obtained capacity building training, and participates in workshop, field demonstration, experience sharing & exposure visits, and 0 if not	0.39
social influence	Pressure of social groups and informal associations on a farmer's behaviour and decision (1 for a farmer who has a strong social capital network and 0 otherwise)	0.61
attitudes	The degree to which a farmer's feeling to adopt sustainable practices by placing a favourable/unfavourable evaluation of the practices. A higher value shows positive or strong attitudes of farmers towards adopting the practices	3.21
personal efficacy	A farmer's belief on personal skill, competence, knowledge, and capabilities to successfully introduce and use sustainable practices. A higher value indicates a presence of satisfactory skill and experience to adopt the practices	3.22
perceived resource	The degree of a farmer's perception on how money, labour, land, and other resources facilitate/impede adoption of sustainable practices. A Higher value indicates that these facilities significantly constrain the adoption of the practices.	3.11

4. 2. How are socio-psychological factors influencing farmers' decisions to adopt sustainable farming practices?

This section explores the factors that influence farmers' decisions to adopt agroforestry systems, organic compost application, and crop rotation with legumes. The results of the multivariate probit, which is estimated by the maximum likelihood method and checked for normality and multicollinearity, is presented in Table 2. The Wald chi-square test indicates that our estimated model is overall significant and the coefficients are jointly different from zero. The rho likelihood ratio test also indicates the error terms' correlation effect to be statistically significant. The covariance of the error terms across the three different equations is significantly correlated, which implies that the choices of these practices are interdependent.

The larger the family, the more labour is available not only for agricultural production but also for non-agricultural activities. This is found to have a positive and significant effect on the adoption of compost fertiliser but an insignificant effect on agroforestry system and crop rotation. The probability of using compost is higher for large families than for small families because agroforestry and crop rotation are considered less labour intensive whereas the others especially compost application is more of labour demanding.

Table 2 shows that literate farmers are more likely to use agroforestry and crop rotation as a mean to enhance productivity and yield. Farmers are more likely to apply agroforestry and crop rotation if they are literate. However, the probability of adopting compost fertiliser declines with education. Literate farmers are less likely to apply compost due to time and labour limits or status issues.

Risk attitude was found to have a positive/negative impact on adoption decision. When sustainable farming practices are perceived to increase risks, risk-averse farmers are less likely to adopt them while risk seeker farmers are more likely to adopt them. The probability of adopting compost is lower for risk averse farmers than their counterparts. Risk seeking farmers are more likely to adopt agroforestry than other farmers.

Agricultural extension service has a significant positive effect on adoption of agroforestry system and crop rotation. At the village level, there are some agricultural extension agents who are assigned by the government and nongovernment to advise farmers about improved technologies and sustainable practices. They can help farmers to become aware of the attributes, advantages, and disadvantages of these practices. Smallholder farmers are more likely to adopt sustainable practices if they have frequent contacts with extension agents (public and private) because they can encourage and/or advise them (how) to apply them. Media access has a significant negative influence to implement crop rotation but it has an insignificant effect on agroforestry system and compost.

At each village, farmers training centres have currently been established and equipped (at least partially) with necessary human resources and facilities with the aim of transferring knowledge about new or improved farming practices pragmatically. These centres are served as farm demonstration sites. Capacity building training and practical workshop are often organised in these centres especially by practitioners to transfer technological innovations and improved farming methods. The result illustrates that technical training has a positive and significant effect on the adoption of compost fertiliser but it doesn't for agroforestry and crop rotation.

Social capital is another explanatory variable of this study. In the study area, social interaction and communication significantly help farmers to exchange information, to harmonise their beliefs and attitudes, and to overcome resource constraints. Table 2 confirms the positive effect of social capital on the adoption of agroforestry system and grain-legume rotational practices. Previous studies have also documented a positive effect in a way that the number of sunflower adopters increased when there was a strong social tie among friends and families (Bandiera & Rasul, 2006), and peers and family members shaped the demand for protecting and preserving land and water resources (Fazio, Baide, & Molnar, 2014). Thus, social capital stimulates farmers to adopt sustainable practices.

Farmers' attitudes have a significant positive effect on adopting crop rotation, agroforestry and compost. Farmers who have positive attitudes towards these practices are more likely to adopt them if they perceive that the practices are useful for them if they are easy to understand, learn and adopt, and if they are compatible with their existing farming values and traditions. Previous studies reported similar findings; a significant impact of farmers' attitudes on adopting of the ecological focus area and private sustainability schemes (Menozzi 2014), and agri-environmental schemes-environmental fallow and use of alternative crops (Barreiro-Hurlé, Espinosa-Goded, & Dupraz, 2008).

The results of the ordered probit model reveal (not seen here) that education, labour supply, social capital, attitudes, intentions and perceived resources have positive effects on the number of practices adopted while risk aversion, livestock, and extension services negatively affect the number of practices adopted. It is less likely for risk averse farmers while more likely for risk seeker farmers to adopt more practices. Literate farmers have adopted more practices than illiterate farmers. Livestock tends to impede farmers to adopt more practices because it seems that animal husbandry and other farming practices compete for time and labour.

Table 2. Coefficients of the explanatory variables of the study (multivariate probit model)

Explanatory Variables	Agroforestry system		Organic compost		Crop rotation	
	Coefficient	*Robust std. err*	*Coefficient*	*Robust std. err*	*Coefficient*	*Robust std. err*
experience (year)	-0.09	0.16	0.03	0.02**	0.59	0.31**
labour supply	-0.01	0.04	0.08	0.04**	-0.08	0.08
education	0.27	0.11**	-0.41	0.17***	-0.65	0.04***
agroecology	0.32	0.23	-0.16	0.24	-0.15	0.04***
extension service	0.28	0.11***	-0.07	0.17	0.19	0.03***
risk aversion	-0.10	0.02**	-0.34	0.12***	0.43	0.71
risk seeking	0.05	0.02***	-0.27	0.23	-0.19	0.08**
intention	0.14	0.02***	0.18	0.02**	-0.17	0.35
technical training	-0.13	0.17	0.23	0.02***	-0.21	0.34
media influence	-0.07	0.28	0.04	0.29	-0.06	0.03**

social capital	0.04	0.02***	0.30	0.18*	-0.02	0.40
attitudes	0.05	0.01***	0.10	0.01***	0.04	0.01***
personal efficacy	0.16	0.23	0.19	0.03***	-0.67	0.60
perceived resource	-0.08	0.17	0.20	0.11***	-0.68	0.32***
Constant	0.07	1.24	-1.30	1.31	13.49	3.72***

Estimated covariance of the correlation matrix

Note: *, ** and *** significant at 10%, 5% and 1% probability of error, respectively

The Wald chi-square test: $(X^2(42) = 1192$, $\Pr ob > 0.000, n = 235$

RHO Likelihood ratio test: $\rho_{agroforestry}=\rho_{compost}=\rho_{rotation}=0$; $\chi(3)=10.76$ Prob>0.011

$RHO_{compost-rotation}=-0.52$ (0.012)**;

$RHO_{agroforestry-rotation}=0.19(0.3346)$

$RHO_{agroforestry-compost}=0.15(0.012)$**

5. Concluding remarks

This article analyses smallholder farmers' decisions to adopt various sustainable practices in six rural villages in northern Ethiopia. Especially it explores how attitudes, normative issues and intentions influence a simultaneous adoption of multiple practices using a sample of 350 randomly selected farmers. The probability of adoption is analysed using a multivariate probit model and the number of adopted practices by an ordered probit model. The finding indicates that although many smallholder farmers in the study areas have implemented these selected sustainable agricultural practices, there are still a significant number of farmers who are not adopting them, which justifies for policy makers and practitioners to undertake efforts to promote these farming practices.

It is also found that education, information, social capital, intentions, attitudes, and risk attitudes are the main determinant factors affecting adoption and number of practices adopted. Specifically, adoption of agroforestry is affected by education, risk attitudes, social capital, intentions and attitudes. Family labour supply, education, livestock, social capital, risk attitudes, technical training, intentions, attitudes and perceived resource also influence the use of compost. Furthermore, the major factors that affect implementation of crop rotation include gender, family labour supply, education, risk attitudes, media influence, social capital, extension services, intentions, and attitudes.

Reference

Adegbola, P., & Gardebroek, C. (2007). The effect of information sources on technology adoption and modification decisions. *Agricultural Economics*, *37*, 55–65.

Bandiera, O., & Rasul, I. (2006). Social networks and technology adoption in northern Mozambique. *The Economic Journal*, *116*, 869–902.

Barreiro-Hurlé, J., Espinosa-Goded, M., & Dupraz, P. (2008). Does intensity of change matter? Factors affecting adoption of agri-environmental schemes in Spain. In *107 th EAAE Seminar*

"Modelling of Agricultural and Rural Development Policies." Sevilla, Spain.
FAO. (2015). *The State of Food Insecurity in the World. Meeting the 2015 international hunger targets: taking stock of uneven progress*.
Fazio, R. a, Baide, J. M. R., & Molnar, J. J. (2014). *Barriers to the Adoption of Sustainable Agricultural Practices :*
Greene, W. (2003). *Econometrics Analysis*. (R. Banister, Ed.) (5ed ed.). Pearson Education, Inc., Upper Saddle River, New Jersey, 07458.
Gumataw, A., Bijman, J., Pascucci, S., & Omta, O. (2013). Adoption of improved potato varieties in Ethiopia: the role of agricultural knowledge and innovation system and smallholder farmers' quality assessment. *Agricultural Systems*, *122,* 22–32.
Hillbur, S. (2014). *Farmer's perceptions of agroforestry-A case study about the obstacles and opportunities for agroforestry adoption in Babati, Tanzania*. Environment and Development, Södertörn University.
Kassie, M., Jaleta, M., Shiferaw, B., Mmbando, F., & Mekuria, M. (2013). Adoption of interrelated sustainable agricultural practices in smallholder systems: Evidence from rural Tanzania. *Technological Forecasting and Social Change*, *80*, 525–540.
Lichtfouse, E. (2012). *Sustainable agriculture reviews 11*. (E. Lichtfouse, Ed.). France: Springer.
Muzari, W., Gatsi, W., & Muvhunzi, S. (2012). The Impacts of technology adoption on smallholder agricultural productivity in Sub-Saharan Africa: A review. *Journal of Sustainable Development*, *5*(8), 69–77. http://doi.org/10.5539/jsd.v5n8p69
National Planning Commission. (2015). *The Second Growth and Transformation Plan (GTP II) by the Federal Democratic Republic of Ethiopia*.
Tam, D. M. Y., & Coleman, H. (2011). Validation study of a gatekeeping attitude index for social work education. *Journal of Teaching in Social Work*, *31*(5), 505–522.
Teklewold, H., Kassie, M., & Shiferaw, B. (2013). Adoption of multiple sustainable agricultural practices in rural Ethiopia. *Journal of Agricultural Economics*, *64*(3), 597–623.
UNCTAD. (2015). *The Least Developed Countries Report 2015: Transforming Rural Economies*. Geneva, Switzerland: United Nations Publication.
Van Thanh, N., & Yapwattanaphun, C. (2015). Banana Farmers' Adoption of Sustainable Agriculture Practices in the Vietnam Uplands: The Case of Quang Tri Province. *Agriculture and Agricultural Science Procedia*, *5,* 67–74. http://doi.org/10.1016/j.aaspro.2015.08.010
Veisi, H., & Toulabi, S. B. (2012). Factors influencing pro-environmental behaviour in agriculture. In *International Conference on Ecological, Environmental and Biological Sciences* (pp. 346–349). Dubai: Environmental Sciences Research Institute, Shahid Beheshti University.
Wollni, M., Lee, D. R., & Thies, J. E. (2010). Conservation agriculture, organic marketing, and collective action in the Honduran hillsides. *Agricultural Economics*, *41*, 373–384.