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Influence of incentives measures for green manure planting adopted by local authorities and farmers perceptions of the use of rotational fallow for agricultural sustainability in Guangxi, China

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Abstract

The influence of instrumental variables on farmers ‘perceptions using rotation fallow as sustainable agriculture practices had been the aim of our research. By using simultaneous equations models, this study tried to understand the relationship between green manure farmer’s perceptions on using rotation-fallow and planting green manure in Guangxi Province, south of China. The results showed that subsidizing green manure farmers based on standard subsidy by the unit of green manure sown area; the training on the green manure planting technology or the demonstration preaching; the green manure farmers preference for the kinds of subsidy (funds, seeds, and mechanical services) were the mostly great drivers of the program of restoring planting green manure in the study area. These incentives measures must be enhanced as priority to restore definitely green manure planting. However, the findings of the study showed that the total income of the 2017 year, the area of an agricultural field of household and the household members (16-65 years old), providing labor in the agricultural field, have some influences on planting green manure and on farmer’s perceptions on using rotation-fallow as sustainable agriculture practices. Brief, the unobserved factors which influenced the endogenous factors play an important role to enhance widely the impact of farmers’ perceptions on planting green manure.

Keywords: *Incentives measures, farmer’s perceptions, Green manure, subsidy, rotation fallow, probit, China*

Introduction

Since the exploitation of natural resources and before the growth of the population due to the reduction of mortality by the progress of technology in the field of medicine, the availability of food has increased more than the population. This prompted some researchers to think about the error of the Malthusian doctrine. According to the largest of land and low density of population, farmers managed to maintain farmland yields through the rotation of farmland because the land used by farmers did not allow for high yields and thus did not increase food supply (Adrian J. P., 1927). Green manure species have different particularities referring to services and functions on sustainable of environmental protection and agricultural economic development such as the quality of soil fertility improvement with the tree species [*medicago Sativa, melilotus suaveolens and astragalus adsurgens*] of green manure: the soils matters content, the total nitrogen contents, the effective phosphorus content, and the instant potassium content were increased by 0.3g/kg, 0.05g/kg, 0.8mg/kg and 7mg/kg respectively (Chen L. et al., 2017).

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The study carried out by Zeng-Qiang, L. I., Jian-Hong, W., & Xian, Z., (2017) pointed out the benefits of green manure planting. For that issue, after returning green manure to soil, green manure crops decomposed and released its nutrients into the soil for improving its structure, increasing soil organic matter content, maintaining the cycle of nutrients in the agricultural ecosystem, enhancing the biomass and activities of soil microorganism. Deng L. C. (2018) compared soil physical and chemical properties and the yield of succession of crops before and after planting green manure, the result showed that the availability of potassium (K) was increased of 17.99%, the organic matter of 25.45%, soil bulk density decreased by 22.55 % and pH has been maintained the same. If considering yield, the succeeding rice crops were increased significantly of 6.62% in two years. Planting green manure crops in fallow-land in winter is a very important strategy for optimizing the agricultural cropping structure in China because the study of ecological services values assessment of practicing winter green manure and spring maize rotation in North of China carried out by Zhuo Z. et al. (2016) reported that planting green manure crop had the following effects:

- Great effect on gas regulation: the benefit accounts for 60.80% to 61% of the total ecological services;
- Great effect on crop production: the benefit account from 19% to 92% of total values and other benefits of planting green manure was the water conservation;
- Soil nutrient accommodation and soil conservation.

Zheng S. et al. (2017) suggested that green manure breeding and cultivation techniques should be carried out according to the variability observed in climate, soils health and crops varieties in different regions. Huichang W. et al. (2017) affirmed that, for several years, the research and development of the mechanization technology are not stable to green manure planting. There is great weak integration between agricultural machinery and agronomy in planting green manure and lack of modernization into green manure use in paddy fields, drylands, and orchards. The issues were observed between the development of machines suitable for green manure planting, seeds improvement, and marketing system and access to inputs; this observation could be explained with reference to different factors intrinsically linked with anthropological realities of the Chinese population. The fall of farmers' interest in the practice models of planting green manure began in the 1990s in favor of the use of chemical fertilizers and the development of synthetic fertilizers industries (Zhongyi L. et al., 2015) introduced by the Chinese Government and which was supported by the adoption of a gigantic program of agricultural mechanization. This program had caused many damages to the environment (loss of biodiversity, unhealthy of soil physical characteristics, less quality of agricultural products, etc.). Then, recently, the public power had initiated the ecological civilization program to moderate farming operations in order to improve the quality of agricultural products, increase the beautification of landscape and safeguard the environment and natural resources. Consequently,

in order to strengthen the Guangxi Local Government policy of restoring the green manure planting initiated in 2013, we aim to know farmers' perceptions of adopting the use of rotation-fallow as sustainable agricultural

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practices. In present study, we identify indicators on which efforts could be concentrated for a harmonious restoring and development of the green manure planting in a specific area.

Literature review

Acceptation/adoption. This concept is a mental process that begins when an individual or operation learns of innovation and ends at the final adoption stage (Rogers, 1962 op.cit. Tanya J. H.et al., 2009). The adoption /acceptation of a policy is influenced by many factors look like the socio-economic characteristics of the household, the knowledge, and awareness about the benefits or opportunity to getting welfare (Yan T, et al, 2016).

Green Manuring. The planting of green manure is a traditional practice worldwide for several years (Adrian J. P., 1927) and abandoned for adopting conventional agricultural fertilizers. Green manure has the functions of nitrogen fixation, improving soil properties and reducing the consumption of fertilizers (Huichang W. et al., 2017). This is economically benefits for farmers because green manure planting providing forage, ensure food security, improving ecological environment and play an important role in developing of traditional agriculture in China (Plum D. and Liangxiaojuan, 2013). In addition, according to green manure planting potentiality, the green manuring assumes weeds, diseases and pests management in cropping fields (Johnson A.W. et al., 1997).

Fallow: The term fallow usually refers to fields left unsown during a period in order to restore soil fertility and physical characteristics. This agricultural practices given many benefits as conservation of soil moisture favors the accumulation of nitrate and help control weeds. The efficiency of fallow depends on cropping systems, tillage methods and soil texture (Staple W.J., 1959) but, China population has been doubled between 1949 and 1980, and the average per capita availability of farmland is 0.1ha (Vaclav S.,1981). Actually, the small farmland needs the combined practice's methods as rotation fallow combined with planting green manure.

Rotation-fallow. The rotation is the practice of using the natural biological and physical properties of crops to benefit the growth, the health, and competitive advantages of crops. It is also a planned green manure practice which consists for crops succession (cash and cover crops) chosen to sustain a farm’s economic and environmental health (Mohler C. L. and Ellen S. J., 2009). This technique has the practical significance of protecting the species diversity, increasing the soil organic matter content and reducing the amount of chemical fertilizer and pesticides (Qian C.et al., 2017). The mixed rotation-fallow of rotational crop and green manure plants controlled root-knot nematode and soilborne fungi on vegetable crops (Johnson A.W. et al., 1997). In China, the planting of green manure crops in fallow farmland in winter is a very important strategy to optimizing the agricultural cropping structure. In northern China, the ecological service value of rotation of *Vicia villosa* and *orychophragmus violaceus* with spring maize rotation were 71 449 and 69 962 yuan per hectare respectively (Zhou Z.et al., 2016). The use of forage crops in rotation with vegetable crops to manage nematodes and soilborne pathogens is often attractive to vegetable and cattle producers. Coastal bermudagrass has been used in crops rotations to reduce yield loss caused by root-knot nematode and soilborne fungi in order to improve quality of agronomic and vegetable

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crops in the Southeastern United States (Johnson A.W. et al.,1997). The conventional rotation wisdom is supported by the following (i) avoid planting the same crop family in the same field (ii) alternate cover crops with cash crops, (iii) alternate deep-rooted crops with shallow and fine rooted crops (iv) precede heavy feeders with nitrogen-fixing cover crops and (v) avoid following a root crop with another root crop (Mohler C. L. and Ellen S. J., 2009).

Government policy: The agro-environmental incentives measures play an important role for farmers participating in policy implementation (Defrancesco E., 2007). Yan T. (2016) have observed that the communication between farmers and the government, the publicity and the transparency of rural residential land use policies must be improved for increasing willingness to transform the vacant rural residence land into cultivated land. In the field of agricultural public policy, Liu Y. et al. (2009) found that the training for technical generalization of nonpoint source pollution was helpful in reducing fertilizer consumption. According to the Maoist policy's goal of raising yields by application of more irrigation and more chemical fertilizers as modern conventional agriculture, the improper application of synthetic fertilizers and lower quantities of organic fertilizers, and the failure to rotate wet and dry crops (especially decreased green manure and legumes planting) are greatly speeding up the soil degradation and polluting water, soil and air. Then, the proper rotation of crops had neglected (Vaclav S.,1981). The National Planting Green Manure Policy could be the supplement to the existing policies on farmland supply for sustainable development such as Law of Land Administration of the People Republic of China (1984-2004) with the objective to increase cultivated land supply to 16000km2, the "Property Law of the People s Republic of China (2007) and the National Land Consolidation and Rehabilitation Plan (2012) with the objective to guarantee cultivated land (Yan T. et al., 2016).

Household income based on farming: the household income was a significant factor for the willingness to transform the vacant rural residential land into cultivated of farmers who were not and were partly living on farming (Yan T. et al., 2016).

Farmer identity: Household conditions (age, assets, size and education Level) (Defrancesco E., 2007 and Liu Y.et al.,2009) and family's management scale and land fragmentation are also the major's factors (Liu Y.et al.,2009) affecting farmer's decision-making process. Whether the farmers lived entirely on the farming they have been affected by their knowledge of the residential land-use policies, their awareness of the consequences of land transformation and their family size (Yan T. et al., 2016).

Land-use: land is an important social and economic resource, and knowing the spatial distribution of land- use and expected location of the future land use change is important to inform decision makers (Anastasiadis S. et al., 2014). In China, land-use has been changed since the establishment of the communist regime in 1949 by the development of urban sprawl, mines, large and small factories, roads, railways, housing, water reservoirs, and irrigation canal (Vaclav S., 1981). The smallholder farming could adapted to produce some crops and emphasizing the comparative advantages of those which leads to trading products and input with other farmers, large and

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medium-sized farmland can increase productivity and contribute as supplement to family labor (Sanctus, N. , Marijke, D. , Luc, D. , Jean, N. , Sam, D. , & Jeroen, B. , 2015). Then, the policy-makers must include farmers in planning new technology practices for reducing limitations to adopting new technology proposed.

Materials and Methodology

A study survey about green manure planting for agricultural sustainable development has been conducted in Guanxi area in May 2018. In total, 336 farmers have been randomly interviewed with a questionnaire face to face and used for analysis in Stata 14.2 (StataCorp LLC). The methods used to analyze the farmer's perceptions on the utilization of rotation fallow for improving the agriculture land quality and the natural resources was originally based on human behavior borrowed from neo-classical economics (Zongo B. et al., 2015). Alternative behavior models were based on an economic theory which predicts that faced with a problem of choice, a rational economic agent chooses the option of utility maximization Gourieroux, 1989, op. cit. Zongo B. et al., 2015).

The expression of the utility function of farmers perceptions $U(0,1)$:

$$U_{ij} = \alpha X_i + \varepsilon_{ij} \qquad (1)$$

Where: α is Constant; X_i is variables; ε_{ij} is error and *j* is equal alternatively either 1= yes or 0=Non; and i is the number of observations.

Thus, the empirical approach used in this study is based on the role of farmers perceptions on the use of rotation-fallow within a conditional maximum likelihood framework (Makate, C.et al.,2017) that takes into account the potential influence of unmeasured factors, jointly are impacting on farmer's perceptions. We start with the logistic regression model for planting green manure (PGM). That model can be expressed with the basic probit regression model as follows:

$$PGM_i = \beta_0 + \beta_1 Per_i + \beta_2 X_i + \varepsilon_i \qquad (2)$$

Where PGM_i is a binary variable which takes the value 1, if the farmer participate on planting green manure and takes the value 0, if otherwise. Per_i is a dummy indicator variable representing the farmers' perceptions on using rotation-fallow in order to improve the quality of natural resources and environment protection; and X_i is a vector of the observed caracteristics believed to influence planting green manure decision of the farmers, including gender, age, education, household size, human workforce 16-65 years old, annual income and land.

The estimation of equation (2) did not takes into account the potential endogeneity factors associated with farmers perceptions on using rotation-fallow. The results are inconsistent estimates. Then, we estimate a second structural equation which estimates the parameters of endogenous variables (Wooldridge J. M., 2012). This endogeneity

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takes origin through the unobserved characteristics which influence farmers' perceptions on using rotation-fallow. For example, some farmers know more than others about green manure. The knowledge level of farmers could be acquired from training, the membership to cooperative or more educated than their counterparts. However, to produce more credible estimates of the influence of farmers perceptions on planting green manure, the following equations system could be estimated:

$$PGM_i = \beta_0 + \beta_1 per_i + \beta_2 X_i + \mu_i \quad (3)$$

$$Per_i = \gamma_0 + \gamma_1 Z + \gamma_2 X_i + \varepsilon_i \quad (4)$$

Where Z is a vector of instrumental variables thought to strongly influence farmers perceptions on using rotation fallow and doesn't affect directly planting green manure. We consider the two-equation structural model (Wooldridge J. M., 2012) and Per_i and Z are endogenous variables of equation (3) and (4) respectively. X_i are exogenous variables of equation (3) and (4) respectively. These variables include knowledge about promoting green manure planting by providing a subsidy standard, technology study training or demonstration preaching, the farming experience, reception of subsidy for green manure planting. An assumption about parameters in order to solve for equation (3), (4) and (5): $\beta_1 \neq 0$. We assume that the error term μ_i and ε_i are uncorrelated.
The equations (3) and (4) are simultaneously estimated through conditional maximum likelihood methods (Roodman D., 2011) with heteroskedasticity - robust standard errors (Wooldridge J. M., 2002). The system of equations is estimated using Stata's conditional mixed process estimator (CMP) (Roodman D., 2011; Makate, C.et al., 2017). The CMP is a flexible tool to estimates systems of equations with various link functions (Tamas Bartus and Roodman David, 2014). Then, we can consistency estimate the parameters of simultaneous equation (3) and (4) by using CMP (Roodman D., 2011) as following:

cmp ($PGM_i = per_i X_i$) ($Per_i = Z\ X_i$)*, ind ($cmp_probit $cmp_probit) technique(dfp) qui robust* (5)

The Davidon-Fletcher-Powell (DFP) algorithm (Gould, W. W., J. Pitblado, and B. P. Poi. 2010) had been used to resolve the difficulty to maximize likelihood functions by eliminating the non-concave regions and achieve the convergence of test from the estimation process. However, the mean and standard deviation were generated by ($\mu = E[X] = \frac{\sum_{i=1}^{n}(X)}{N}$) and ($\sigma = \sqrt[2]{\sigma^2}$) (Howard J.S., 2015) respectively.

Table-1. Descriptive statistics and variable definitions (n=336)

Variable	Variable definitions and measurement	AV	SD

Gender	Binary variable = 1 if farmer is female, 0 male	0.390	0.488
Respondant_age	Respondent's age in years at the time of the survey	53.946	13.820
Education level	Respondent's level of completed education	1.545	0.802
Household_size	The household size	5.036	0.546
Log_income	The logarithm of the total income of the 2017 year	0.886	0.874
Log_agrifield	The logarithm of the area of an agricultural field of household	0.716	0.816
Training	The binary variable =1 if farmer participation in green manure planting technology study training or demonstration preaching, o otherwise	0.116	0.321
Log_distance	The logarithm of the distance between the household home and nearest green manure demonstration basis	0.596	1.589
Farming experience	The age of farming experience is between the starting year for planting green manure until 2017	15.104	22.288
Log_gmcost	The logarithm of the cost of green manure planting in 2017	0.522	1.291
Substarec	The logarithm of standard subsidy received for green manure planting in yuan	0.912	1.696
Sub_fun	Binary variable =1 if farmer believe that standard subsidy has obvious effects on promoting green manure planting, 0 otherwise	0.155	0.362
PGM	Binary variable =1 if farmer plant green manure plants in the agricultural field, 0 otherwise	0.655	0.476
per	Binary variable =1 if the farmer has the willingness to accept the government green manure planting policy based on crops rotation fallow technology in an agricultural field in order to improve the agricultural land and natural resources quality, 0 otherwise.	0.113	0.317
Agri_labor force	Number of household members (16-65 years old) who provide labor in the agricultural field	1.497	1.161
work	Binary variable =1 if the household has a member in agricultural enterprises, cooperatives or other new employment similar to an agricultural management organization, 0 otherwise	0.045	0.207
Suppol	Binary variable =1 if farmer prefer one of the three types of subsidy (funds, seeds, mechanical services or tools), 0 otherwise	0.342	0.475

Results and analysis

4.1. Demographic characteristic of respondents

In the table-1, we show the variable measurement, description and summary statistics (mean and standard deviations) for the variables used in our analysis. Growers of green manure plants ranged in age from 22 years to 90 years old with an average of 53.9 years and were predominantly male (61.01%), primary school and below (61.12%) and an average of household size (5.04) (table-1&2.). Considering the number of agricultural labor forces (16-65 years old), the majority (60.24%) of the respondents had a household size of from one to two members of agricultural labor forces, followed by family who have household-size from three to four members (11.87%) and from five to six members (0.89%) (table-3).. Most households (95.25%) did not have a family member in agricultural enterprises, cooperatives or other news employment similar to agricultural management organization. Only 4.45% of the respondents are represented in some agricultural organization (table-3). Most of the respondents (44.21%) have five or six members of the family, followed by 37.98 % of respondents with three

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or four family members, 8.90% of the respondents with seven or eight family members and 4.45% of respondents with one or two and nine or plus family members (table-2.) with an average of five members as size of household (table-1.). In table-2, the cumulative percentage of frequencies of age showed that 81.01% of respondents have the age between 22 and 65 years old.

Table -2. Demographic characteristics of respondents (n=336)

Variables	Number of respondents	Percentage (%)
Sex of respondents		
Male	205	61.01
Female	131	38.99
Age of respondents		
[20, 29]	18	5.34
[30, 39]	39	11.57
[40, 49]	42	12.46
[50, 59]	90	26.71
[60, 65]	84	24.93
[66, 69]	19	5.64
[70, 79]	37	10.98
[80, plus]	8	2.37
Education level		
Primary school and below	206	61.12
Secondary school	90	26.73
High school (University)	27	8.01
Specialist (Doctoral degree)	13	3.86
Household size		
[1, 2]	15	4.45
[3, 4]	128	37.98
[5, 6]	149	44.21
[7, 8]	30	8.90
[9,plus]	15	4.45

4.2. Description of respondents' perceptions of farmers 'operations variables

On average, the growers of green manure crops who have the interest to use rotation – fallow for a number of years participated with 11.28 % (table-1&3). Planting green manure plants in farmland are represented by 38.99% of respondents and 11.61% of respondents have participated in green manure planting technology study training or demonstration preaching. The obvious effects of the standard subsidy on promoting green manure planting have been believed by 15.48 % of respondents. Most of the respondents (66.67%) have green manure planting experience between zero and 15 years. The farmers who have from 31 to 45 years and from 46 to 60 years of green manure planting experience are represented respectively by 16.96%, and 10.71% of respondents (table-3).

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Table-3. Characteristics of respondents 'operation (n=336)

Variables	Number of respondents	%
Perception of farmers (per)		
1= farmer want to use rotation fallow in the agricultural field	38	11.31
0= otherwise	298	88.69
Planting green manure (PGM)		
1 = farmer participate to plant green manure plants in the agricultural field	130	38.69
0= otherwise	206	61.31
Training		
1= farmer participate in green manure planting technology study training or demonstration preaching	39	11.61
0 = otherwise	297	88.39
Subfun		
1 = farmer believe that standard subsidy has obvious effects on promoting green manure planting	52	15.48
0 = otherwise	284	84.52
Agri_labor force		
[1, 2]	203	60.24
[3,4]	40	11.87
[5,6]	3	0.89
work		
1= the household has a member in an agricultural enterprise, cooperative or other employment similar to an agricultural management organization	15	4.46
0 = Otherwise	321	95.54
Farming experience		
From 0 to 15 years	224	66.67
From 16 to 30 years	7	2.08
From 31 to 45 years	57	16.96
From 46 to 60 years	36	10.71
From 61 to 70 years	12	3.57
Suppol		
1= if farmer prefer one of the three types of subsidy (funds, seeds, mechanical services or tools)	115	34.23
0=otherwise	221	65.77

4.3. Farmers 'perceptions factors on using rotation fallow and planting green manure

In general, the responses of willing to use rotation fallow are less than 50% and farmers who have a field of green manure are also less than 50% of respondents (see details in figure number one).

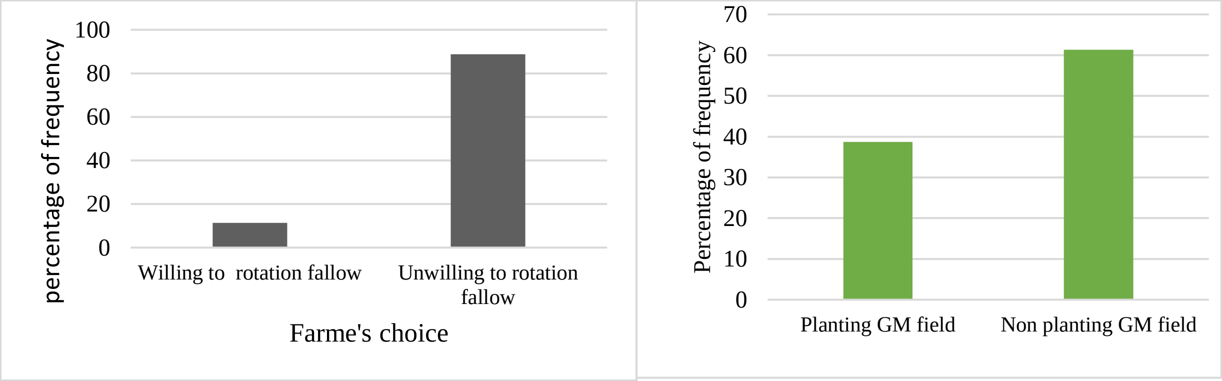

Fig.1. Farmer's perceptions on rotation fallow and planting green manure (GM)

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A greater part of farmers was reluctant to plant green manure and to use rotation fallow for the sustainability of agriculture. We find that the reasons were the farming experience (Zhongyi L. et al., 2015) and low ecological compensation (Huanlin Xie et al., 2017). We estimated two models differentiated each other by the number of instrumentals variables. More consistency coefficients have been observed in the models with less instrumentals variables (M2). This findings showed that among a big group of many elements, the drivers are constituted by a small group of elements. In our case, three instrumentals variables have mostly a great influence on planting green manure in Guangxi Province because they increase the level of farmers ‘perceptions on using rotation-fallow for the sustainability of agriculture. However, the different consistency coefficients come from the variation of a system of instrumental variables (*SUPPOL*, *SUBFUN*, *SUBSTAREC, LOG_GMCOST*, *LOG_DISTANCE*, *TRAINING*, and *FARMING_ EXPERIENCE)*. The table (4) and (5) show that the preference of a type of subsidy (funds, seeds, and mechanical services) *(SUPPOL);* farmer’s participation in green manure planting technology study training or demonstration preaching (TRAINING) and farmer’s believing on the effects of standard subsidy on promoting green manure planting *(SUBFUN)* were the strongly drivers of the program of promoting planting green manure in Guangxi Province. Therefore, SUPPOL influenced significantly the farmer ‘perceptions. The findings results showed also that household members (16-65 years old) who provide labor in the agricultural field *(AGRI_LABORFORCE),* the area of an agricultural field of household (*LOG_AGRIFIELD)* and the total income of the 2017 year *(LOG_INCOME)* were the exogenous factors which influenced significantly planting green manure.

Discussions

The agriculture sustainable development could be improved by integration of different agricultural practices and crops rotation fallow technology based on natural resources utilization in farming. The adoption of using rotation-fallow in farming could improve food security by ingeniously modifying traditionally agroforestry, water and soils management practices (Etongo D. et al. 2018). That modification of those practices could make help to households by finding any opportunities to increase the income of the family and with sufficient degree to substantially alleviate poverty (Julio A et al. 2007). In the past, the traditional green manure planting was used to improve soil fertility, but with the development of chemical fertilizer industries since the 1990 year, the planting area of green manure decreased rapidly until to 133, 000 hectares in 2012 (Zhongyi L. et al., 2015). Because of the only goal of Maoist policy of indiscriminate grain growing expansion with rising yields, the improper application of synthetic fertilizers and lower quantities of organic fertilizers and the failures to rotate wet and dry crops are greatly speeding up the soil degradation (Vaclav S., 1981). By using chemical fertilizers, farmers produce more than traditional practices in order to eliminate food shortages; the use of machinery in agriculture development had the same objective of mitigation of hunger.

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Table-4. Results of conditional mixed process (Cmp) estimation and IV-postestimation tests

Dependents variables	Independents Variables	M1	M-2.
Planting green manure (PGM)		***Coeff.***	***Coeff.***
	per	-1.428 (5.80)**	1.617 (4.93)**
	sex	0.001 (0.01)	0.080 (0.30)
	age	-0.011 (1.35)	-0.012 (1.23)
	educ	0.007 (0.05)	-0.198 (0.89)
	Household_size	-0.061 (1.25)	-0.028 (0.57)
	work	0.717 (1.40)	-0.205 (0.50)
	agri_laborforce	0.277 (3.21)**	0.108 (1.54)
	log_agrifield	0.841 (5.04)**	0.693 (3.55)**
	log_income	-0.450 (4.54)**	-0.462 (2.53)*
	_cons	-0.000 (0.00)	0.277 (0.37)
Farmers perceptions (per)	***Instrumental variables***	***Coeff.***	***Coeff.***
	Suppol	-0.730 (3.32)**	1.449 (3.88)**
	Subfun	0.092 (0.15)	0.164 (0.31)
	training	0.374 (1.19)	
	Substarec	-0.006 `(0.04)	0.017 (0.14)
	Log_gmcost	0.007 (0.08)	
	Log_distance	0.142 (1.99)*	
	Farming experience	-0.023 (3.22)**	
	Exogenous variables	-0.032 (0.19)	
	sex	-0.002 (0.22)	-0.089 (0.36)
	age	0.107 (0.61)	0.015 (1.27)
	educ	-0.089 (1.38)	0.332 (1.26)
	Household_size	0.468 (0.99)	--0.022 (0.45)
	work	0.306 (3.26)**	0.409 (0.98)
	agri_laborforce	0.682 (4.47)**	0.193 (2.79)**
	log_agrifield	-0.348 (2.48)*	-0.105 (0.59)
	log_income	-0.963 (1.34)	0.216 (0.78)
	_cons	7.663 (3.51)**	-3.315 (4.16)**
	atanhrho_12	7.663(3.51)**	-8.509 (0.48)
	Rho_12	-0.99	-0.99
	N	336	336
	Wald chi2*	*(23) 192.92	(20) 310.61
	Log pseudolikelihood	-216.51	-227.77
IV-postestimation test			
2SLS			
Test of endogenous	Robust score chi2(1)	0.578 (p = 0.45)	21.81 (p = 0.00)
	Robust regress. F(1,325)	0.534 (p = 0.47)	40.59 (p = 0.00)
Test of first stage	R-sq.	0.2206 Prob > F=0.004	0.1772 Prob > F= 0.32
Test of overidentification.	Score chi2*	*(6) 142.022 (p = 0.00)	*25.067 (p = 0.00)
GMM			
Test of endogenous	GMM C statistic chi2 (1)	1.914 (p = 0.176)	7.84 (p = 0.00)
Test of the first stage	R-sq.	0.2206 Prob > F=0.004	0.1772 Prob > F= 0.32
Test of overidentification.	Hansen's J chi2*	*(6)142.022 (p = 0.00)	*(2) 25.067 (p= 0.00)

Notes: ***significant at 1%, **significant at 5%, and * significant at 10%

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Table 5. Average marginal effects of farmer's perceptions 'factors on planting green manure and on utilization of rotation-fallow

Variables	M-1	M-3
PGM	***Dy/dx***	***Dy/dx***
per	-1.427	1.617
	(-5.8)***	(4.93)***
agri_laborforce	0.276	0.108
	(3.21)***	(1.54)
log_agrifield	0.840	0.693
	(5.04)***	(3.55)***
log_income	-0.450	-0.462
	(-4.54)***	(-2.53)***
per	***Dy/dx***	***Dy/dx***
Suppol	-0.7305	1.449
	(-3.32)***	(3.880)
Subfun	0.0914	0.164
	(0.15)	(0.310)
Training	0.374	0.017
	(1.19)	(0.140)
Substarec	-0.0062	
	(-0.04)	
Log_gmcost	0.0068	
	(0.08)	
Log_distance	0.1418	
	(1.99)**	
Farming_experience	-0.0229	
	(-3.22)***	

Notes: ***significant at 1%, **significant at 5%, and * significant at 10%. Reported are average marginal effects and their heteroscedasticity robust standard errors shown in parentheses.

However, the lesson obtained from our results is that farming experience is more significant and had a negative impact on using rotation fallow as sustainable agriculture practices because of 66.67% of respondents have from 0 to 15 years of farming experience and 38.69% of respondents had adopted planting green manure. This can also be explained by historical farming and its consequences on outputs. The food shortages and Maoist policy application in agriculture have many evolvements of farmer's attitude and behavior change in farming. Then, we observed in research findings this high degree of significance of farming experience which impacted negatively on farmer's perceptions based on using rotation fallow in Guangxi. Jointly, all instrumental variables selected contributed to the negative and significant influence of the farmers' perceptions and on adoption of green manure planting (Table-5, M-1). By reducing one by one the instrumental variables, three factors has been selected because they greatly influenced consistency the farmer's perceptions and the adoption of planting green manure(Table-5, M-2).

In order to reduce this negative and significant impact of green manure farming experience on planting Green manure (PGM), the department of agriculture of Guangxi has published a series of guidelines on the development of green manure for the promotion of beautiful villages construction, winter field, and spring opportunities to develop the agriculture of leisure and local tourism because at the same time green manure was considered an important part of the action plant for the increase in grain of 3 million (Zhongyi L. et al., 2015). Additionally to the outcomes from farm yield, local government subsidized green manure farmers based on standard subsidy by the unit of green manure sown area. That is one of the kinds of incentives activities of the Chinese Government to increase the income of green manure farmers. He supported the

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training on the green manure planting technology or the demonstration preaching. That training program aims to increase the knowledge of the farmers about the importance of planting green manure. The subsidy provided by the Government contribute to reduce the cost of green manure planting activities. Green manure planting cost is one of the issues of farmers related to expenditure on labor, seeds, weeds management, pest and disease controls, etc. This study considered that the green manure farmer's preference of kinds of subsidy were most suitable query for understanding the farmers 'attitudes for maximizing the future cultivation of green manure. The green manure demonstration basis installed in different sites in Guangxi province were a suitable way to enhance the farmer's knowledge in green manuring technology for agriculture sustainable development (Table-4 and 5, M1 and M-2).

Conclusion

The conventional agriculture adopted by the Chinese Government to use at high-level synthetic fertilizers had modified the attitudes and agricultural practices in Guangxi, South of China. This research aims to assess the perceptions of farmers on the use of rotation fallow based to incentives measures adopted by local authorities. We carried out the analysis of the endogenous and exogenous factors which influence planting green manure and farmers' perceptions. Our methodology has been adopted by taking into account the potential endogeneity bias from unobserved factors which have a great influence on farmer's perceptions and but not associated directly with planting green manure (PGM). The study used a dataset collected in May 2018 from farmers in Guangxi. Our research tried to understand the relationship between farmer's perceptions and planting green manure for agriculture sustainable development by using conditional maximum likelihood with heteroscedasticity-robust standard error. The results showed that the farming experience conducts to a negative and significant impact of farmer's perceptions on planting green manure. Nevertheless, the incentives measures such as the local government subsidy of green manure program; the farmer's training on the green manure planting technology and the green manure demonstration basis in different research sites could restore planting green manure and behavior change of farmers. These mentioned incentives measures play a great role in the future for rotation-fallow technology adoption. In addition, some exogenous factors likely the total annual income, the area of an agricultural field of household and the household members (16-65 years old), providing labor in the agricultural field, have effects on farmer's perceptions and on the utilization of rotation-fallow in planting green manure. Brief, the instrumental factors play an important role to enhance widely the impact of farmers' perceptions on planting green manure.

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Acknowledgments: This study was supported by the China Scholarship Council (CSC), No: CSC/2017GBJ009591.

Author's contributions: NTAKIRUTIMANA Leonard had the original idea for the study, data analysis, methodology conception, and paper writing. Dr. Prof. YIN Changbin was supervisor of the study and performed the analysis. LI Fuduo had participated into data collection, done the re-lecture of this paper before submission.

Conflicts of interest: The authors declare no interest conflict

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