Impact of livestock Scale on Rice Production in Battambang of Cambodia

D SIEK[1,2], S W XU[1*], WYU[1] , A-G AHMED[1]

[1] Agricultural Information Institute, Chinese Academy of Agricultural Sciences, Beijing, China 100081

[2] Regional Polytechnic Institute TechoSenBattambang, Ministry of Labor and Vocational Training, Battambang, Cambodia

*Corresponding author, E-mail: darith9398@yahoo.com, xushiwei@caas.cn

Abstract. Increasing the awareness of environmental protection especially in the rural regions is important as most the farmers reside in that region. Crop-livestock proudciton has proven in many ways to encourage environmental protection. This study analyzes among other factors the impacto of livestock scale on rice production. Two regressions: Ordinary Least Square (OLS) and stepwise regression was applied to investigate these interrelationship. The result stress of three factors encouraging livestock production namely size of farmland, scale of livestock and income acquired from other jobs. The study further provides recommends to the government based on the findings of the study.

Key word: livestock; rice; environment; Battambang; Cambodia

1. Introduction

The world's population growth is projected to reach around 9.1 billion by 2050 which pushing up the value of food consumption would need to rise by 70% and 3 billion tonnes (up from today's nearly 2.1 billion tonnes) of cereals for both food and animal feed; and food production in the developing country would need to almost double(FAO, 2009).Cambodia is one of developing country with the population estimate in 2016 is about 18 million (World Bank, 2016) and is growing rapidly about 1.83% per annum(CIPS 2013). In Cambodia today, Agricultural sector has been playing a crucial role in developing food security, economic growth and employment especially in the rural community (MAFF, 2015). Approximately 80 percent of the population resides in rural areas and 71 percent are estimated to be solely dependent on agriculture (largely rice cultivation) for their livelihoods (USDA, 2010). Rice is the overwhelmingly predominant food crop, being grown on an estimated 3.3 million hectares or nearly 85.3 percent of the country's total cultivated area (CAC, 2015). The rice cultivation grown are incredibly diverse, with crop scientists estimating there are over 3000 varieties being cultivated in the country which is dissected by several major rivers, including the Mekong and Tonle Sap, and is covered by ancient, highly-weathered and chemical fertilizer use is extremely low and native soils are often very infertile (USDA, 2010). The United Nations Food and Agricultural Organization (FAO) estimates that Cambodia has the lowest rate of fertilizer use for rice in Southeast

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.
Published under licence by IOP Publishing Ltd

Asia, with only about 30 percent of total area receiving minimal application, and Cambodia rice was declared the world's best in its taste at the Competitive Rice Tasting event held at the 2013 Rice Traders World Rice Conference held in Hong Kong and awarded top prize at the Rice Trader World Rice Conference in Bali, Indonesia. As at 2016, the annual paddy rice production is about 9.5 million MT (5.7 million MT, milled basis) with an increase of 200,000 MT from year 2015 (FAO, 2016), and expected to reach10.85 million MT in 2018 (NSDP, 2015). According to MAFF, the average rice yield achieved in 2013 was at 3.163 MT/ha, around 11.52% increase over 2009 (rice yield in 2009 reached by 2.836 MT/ha); and comparing to it neighbouring countries, its yield is relatively low; Laos (4.2 MT/ha), Vietnam (5.8 MT/ha) and Thailand (3.1 MT/ha).

The low use of fertilizer by the Cambodian farmers is on one hand partially due to it unavailability or high price and on the other hand, due to the increase use of livestock manure as substitute or as a means of taking advantage of the high market prices of organic rice. The increasing engagement of livestock in rice production practices by the rice farmers is overwhelming. This study attempt to investigate whether the changes in livestock scale has adverse effect on the total rice output of the farmers in the rural region. Other factors such as the demographic status and socioeconomics of the farmers are as well. Applying Ordinary Least Square (OLS) and stepwise regression, the study will analyse the factors influencing rice output and furthermore, the study will provide recommendationsbased on the findings.

2. Methodology

2.1. Data resource

The data used in this study were conducted in Battambang province of Cambodiain 2015, involving 18 villages, 12 communes and 6 districts. 204 standard questionnaires were collected after the face to face interview with household farmers. Key informants were selected to be interview gathering useful and confidential information such as: demography, population, total cultivation area and agrarian crop-livestock farming system in target area. Data collected were processed and analyzed in Agricultural Information Institute (AII) of Chinese Academy of Agricultural Sciences (CAAS) Beijing.

The selected province Battambang is situated in the north-western of Cambodia which is about 291km from Phnom Penh city. With the well-known of vast land and long history of conventional rice farming, Battambang is one the province in the Tonle Sap reservoir and the second largest city in Cambodia with total population 1,121,001 and 1.79% for annual growth rate of population during 2008-2013 (CIPS, 2013). This region experiences two seasons: wet season (May to October) and dry season (November to April) with an estimated rice yield of 2.8 and 3.8 MT/ha in wet and dry season respectively (MAFF, 2015).

2.2. Data descriptive& statistics

As shown in Table 1, majority of the farmers (72%) operate rice area less than 3 hectares. About 63.2% of the farmers own 8 or less livestock unit (lu) ratio. The "lu" was defined byChilonda and Otte (2006) to principally represent an exchange unit among different species of livestock. This study used lu converting other livestock (pig and chicken) to cattle applying the standard cattle coefficients of about 0.4 pig and 0.02 chicken.More than half of the farmers in the region are aged farmers about 45 years. More so, the farmers are less educated. About 78.4% of the household are small have small family member equal or less than 5 persons and with lesser members are above 18 years to be considered as able labor force. Despite this, the younger children are still engaged in the farming activities. Off-farm jobs provided extra cash to farmers other than their farming activities.

Table 1 Descriptive statistics of mean and group variables of rice production

Variable	Definitions	Group	Obs.	Mean	Rice production (ton)
r_area	Rice area for farmer household working	> 3 ha	57	6.05	14.777
		≤ 3 ha	147	1.82	4.988
lu	Livestock Unit: livestock standard in cattle unit coefficients	> 8	75	13.05	8.872
		≤ 8	129	4.95	7.055
size_labor	Labour size per household	> 3	67	4.76	9.312
		≤ 3	137	2.18	6.946
size_family	Family size in household	> 5	44	6.77	8.54
		≤ 5	160	3.94	7.498
edu_hh	Education level for household farmers	> 5 grade	94	8.23	8.338
		≤ 5 grade	110	2.55	7.198
age_hh	Age for household farmers	> 45 years	113	55.96	8.346
		≤ 45 years	91	34.4	6.949
farm_off	Dummy variable: 1=Labour off-farm job in household; 0=others	1	38	--	10736
		0	166	--	7.033
_Idistrict_i	AekPhnum	*_Idistrict_1*	39	--	5.599
	Banan	*_Idistrict_2*	31	--	6.139
	MoungRuessei	*_Idistrict_3*	37	--	9.114
	RatanakMondol	*_Idistrict_4*	20	--	6.344
	Sangkae	*_Idistrict_5*	47	--	7.683
	ThmaKoul	*_Idistrict_6*	30	--	11.387

Model Specification

Initially, all information from research were entered into EpiData software for coding and grouping variables, and then transferred to STATA software for further data generation, regression and analysis In this tool, the multiple regression models using Ordinary Least Squares (OLS) were considered the relating performance on the rice production as dependent variable and a set of demographic and socioeconomic aspect of the household (Jeffrey, 2009,Hutcheson, 2011 and Stock, 2015). This variable included cultivation area for rice, livestock standard in cattle unit coefficients, size of labor, family size, household education, farmer'sage, off-farm job and other districts variables.The econometric analysis is shown in the constructed models below:

RegressionModel:

$$Ri_total = \beta_0 + \beta_1 Lnarea + \beta_2 Lnlu + \beta_3 Lnsizlabor + \beta_4 Lnsizfami + \beta_1 Lnedu + \beta_2 Lnage + \beta_7 dum_offarm + \beta_8 LnIdistrict + \varepsilon_i \quad (1)$$

Theconstantsβ_0,β_1....$\beta_8$are the coefficients of parameters of the econometric model that demonstrated the direction and strengths of the relationship between Ri_total and the demographic and socioeconomic factors of the household farmers while the$\varepsilon_i$is explain the error term assumed to be distributed logistic. The *"ln"* after the coefficients is the logarithms of the variables. There are two

type of regression model. The first model is the direct running of the regression (equation 1), while second model is the stepwise OLS regression of equation (1).

3. Results and Discussions

The study applied both OLS and stepwise regression to analyse the rice output of Cambodian farmers via thesocioeconomicinfluencers including the rice cultivated area, livestock owned, and the economic and demography of the farmers. The definition and descriptive statistics of these influencers are shown in Table 1 above where the total rice outputs of different groups of each influencing factors. The table below (Table 2) on the other hand is the OLS and stepwise result. The result explains that three major factors stand out to be significantly influencing the total rice output in the two regressions.Although at different magnitude and level of significance especially on the impact of lu on rice output. As shown in Table 2, the factors include size of farmland, number of livestock which is put in unit "lu" (see Table 1) and off-farm jobs. All the three factors are positively related to total rice output of the farmers. The relation between rice output and farmland is of course obvious. As farm land increase so would bethe rice output given all other factors remain the same.

Table 2.The regression result of rice production

Variable	Definitions	OLS model			Stepwise		
		Coef.	T-value	P>T	Coef.	T-value	P>T
lnr_area	Logarithm of land area	6.340	13.92	0.000	6.359	15.07	0.000
lnlu	Logarithm of livestock standard in cattle unit coefficients	0.952	2.08	0.039	0.091	1.75	0.027
lnsize_labor	Logarithm of size labour	0.063	0.17	0.862	--	--	--
lnsize_family	Logarithm of size family	-1.235	-1.17	0.245	--	--	--
lnedu	Logarithm of household's education	0.053	0.64	0.520	--	--	--
lnage	Logarithm of household's age	0.754	0.68	0.496	--	--	--
Off-farm	Dummy variable: 1=Labour off-farm job; 0=others	3.037	3.72	0.000	2.665	3.69	0.000
_Idistrict_2	Banan	-0.226	-0.22	0.828	--	--	--
_Idistrict_3	MoungRuessei	-0.366	-0.37	0.714	--	--	--
_Idistrict_4	RatanakMondol	-0.536	-0.44	0.657	--	--	--
_Idistrict_5	Sangkae	0.019	0.02	0.982	--	--	--
_Idistrict_6	ThmaKoul	1.786	1.73	0.086	1.906	2.38	0.017
_cons	_cons	-0.774	-0.2	0.845	1.279	2.23	0.027
No.of obs.	Number of obs		202			203	
R^2	R-squared		0.60			0.59	
Adj R^2	Adj R-squared		0.58			0.58	

The interrelationship of livestock and rice output is that of biodiversity explaining that with more livestock, there are better chance of increasing rice output taking into account the advantages of crop-

livestock production. In other words, livestock production encourages rice production. The manure of livestock serves as one of the major source of rice fertilizer in Cambodia especially during periods when fertilizer becomes too expensive or unavailable to the farmers and in turn, the rice straw, rice bran and in some cases broken rice are used as sources for the livestock feed. The crop-livestock practice not only provides cheap feed for the livestock or cheap organic fertilizer for the rice plant, it also reduces the chemical print in the environment. In Cambodia, more farmers are beginning to practice the use of organic manure. This development is pushed by the high prices of organic rice in the market. The third factor encouraging rice production is the income from off-farm jobs. With increase in income from other jobs, the farmer can invest more on factors which increases their rice output e.g. leasing more land or increasing direct beneficiary livestock such as cattle, sheep, goat pig and other larger livestock. With increase in income, the farmer will be able to afford essential inputs.

4. Conclusions and Recommendation

The study analysed the socioeconomic factors of the farmers, livestock scale, and income from other sources to determine which factor(s) have greater impact to increasing rice output in Battambang of Cambodia. Two regressions: Ordinary Least Square (OLS) and stepwise regression was applied to investigate the interrelationship and impact of the factors to total rice output. Three major factors stand out to encourage rice output in the region and they include the size of the farmland, the scale of livestock and income generated from other jobs. The high market price of organic rice has given a boost to the number of farmers involving livestock to their rice production for rich and cheap manure. Given these opportunity, the Cambodian government should continue to encourage and guide farmer on crop-livestock production, increase the awareness of environmental protection especially in the rural regions.

References

[1] CAC (2015) Census of Agriculture in Cambodia 2013, National Report on Final Census Results. National Institute ofStatistics, Ministry of Planning in collaboration with the Ministry of Agriculture, Forestry and Fisheries, Cambodia

[2] Chilonda P and Otte J 2006:Indicators to monitor trends in livestock production at national, regional and international levels. *Livestock Research for Rural Development. Volume 18, Article #117.* Retrieved December 20, 2016, http://www.lrrd.org/lrrd18/8/chil18117.htm

[3] FAO 2009, Global agriculture towards 2050, Food and Agriculture Organization of the United Nations, paper prepared for How to feed the World in 2050: High-level expert forum , Rome. www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf.

[4] FAO (2016) FAO Rice Market Monitor (RMM), Trade and Markets Division, Food and Agriculture Organization of the United Nations, Volume XIX issue No. 3http://www.fao.org/economic/RMM.

[5] FAOSTAT(2016) Online Database, Food and Agriculture Organization of the United Nation (accessed December 18, 2016)http://www.fao.org/faostat/en/#data/QC

[6] Hutcheson, G. D. (2011). Ordinary Least-Squares Regression. In L. Moutinho and G. D.Hutcheson, The SAGE Dictionary of Quantitative Management Research. Pages 224-228.

[7] Jeffrey M. Wooldridge (2009), Introductory Econometrics: A Modern Approach, 4th ed., Cengage Learning. Chapters 3 - 7.

[8] Moul Thon (2016) **Municipality** and Province Investment Information, Battambang province.http://www.cambodiainvestment.gov.kh/content/uploads/2014/03/Battambang-Province_eng.pdf

[9] MAFF (2015) Ministry of Agriculture, Forestry and Fisheries, Agricultural Sector Strategic Development Plan 2014-2018, Kingdom of Cambodia.

[10] NIPS (2013) Cambodia Inter-censal Population Survey 2013, National Institute of Statistics , Ministry of Planning, Phnom Penh, Cambodia; Sponsored by United Nation Population Fund

Japan International Cooperation Agency.
[11] NSDP (2015). National Strategic development Plan 2014-2018, Royal Government of Cambodia. Phnom Penh, Cambodia.
[12] Stock, James H. and Mark W. Watson (2015), Introduction to Econometrics,3rd ed., Pearson Addison-Wesley. Chapters 4 - 9.
[13] USDA, (2010) CAMBODIA: Future Growth Rate of Rice Production Uncertain, Commodity Interlligence Report, United State Department of Agriculture, Foreign Agricultural Servicehttps://www.pecad.fas.usda.gov/highlights/2010/01/cambodia/
[14] WorldBank (2016). World Development Indicators (accessed December 17, 2016) http://databank.worldbank.org/data/reports.aspx?source=2&series=NY.GDP.MKTP.CD&country=KHM