Journal of Rural Development, Vol. 38 No. (1) pp. 102-122
NIRDPR, Hyderabad.

ROLE OF MICROCREDIT AND TECHNOLOGY ADOPTION IN SUSTAINING FARMERS' WELFARE

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ABSTRACT

Poverty in rural areas of Indonesia is still a persistent problem. This paper analyses a virtuous circular causal relation among microcredit, agronomic technology and rural prosperity, and to determine factors affecting farmers to access microcredit and adopt technology in Indonesia. Data for this study were compiled from a survey that interviewed 220 of farm households. Samples of the study were randomly selected from chilli farming community in three regions of Java during 2013-2014. This paper employed a structural equation modelling, which enables to estimate a model of circular causal-interrelations. Microcredit provided positive direct and indirect impacts on rural prosperity. Indirect impact of microcredit was due to mediation of technology adoption. Farmers' decision to access microcredit and adopt technology was determined by farmers' characteristics and agribusiness environment via both exogenous and endogenous manners. Microcredit and technology have been able to secure a virtuous circle of enhancing farmers' well-being. The virtuous circle was to augment farmers' business in terms of larger farming size. Policy makers should introduce more advanced technology and provide credit facility at the same time to ensure sustained economic development in rural areas.

Keywords: Agricultural Finance, Intensive Farming, Virtuous Circle, Structural Equation Modelling.

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Introduction

Many developing countries undergo vicious cycle of rural poverty. Low level of income prevents savings, impedes capital growth, hampers productivity, and keeps income low. If the countries have stepped to invest more, improve knowledge, develop labour skills, and control population growth, they can break vicious cycle of poverty and stimulate a virtuous circle of rapid economic growth. Economic growth can be seen as a virtuous circle. It could start with exogenous factors like technological innovation. As people get familiar with a new technology, there could be learning curve effects and economies of scale. This could lead to reduction in costs and improvement productivity. Microcredit is expected to cut the vicious circle and form the virtuous one through adoption of technology.

In general, microcredit is a specialised, group-based financial service that targets the poor and the marginalised, those who cannot gain access to loans from conventional banking services. Since its beginning about three decades ago, Gauri and Galef (2005) revealed that microcredit has moved to the centre stage of most poverty alleviation initiatives in Bangladesh. The fundamental application of credit as livelihood leverage, particularly for women, has guaranteed the rapid spread of micro-crediting systems through both grassroots and dominant financial institutions in many developing countries (Hossain, 2003; Corsi et al., 2006). The perceived regional success of microcredit has led to its scaling up to the international level, with the United Nations declaring that it would use microcredit as a major strategy for achieving its millennium development goals (Elahi and Danopoulos, 2004; Younus, 2005).

Improvement in the standard of living is associated with accessibility of microcredit. Credit allocated by banks increases business escalation to the real sectors, then promotes economic growth, decreases unemployment rate through increase in labour demanded, increases income and then decreases poverty (Sipahutar et al., 2016). Fofana et al. (2015) found that microcredit group on average had a higher income and a higher value of household assets than the non-borrowers.

Micro-finance fits very well into the socio-economic realities of the rural poor in India, and effectively contributes to their economic prosperity. The majority of beneficiaries of micro-finance did not possess necessary endowments, technical skills and qualifications for availing formal institutional finances. Micro-finance has tremendous potential for reducing economic inequality and rural poverty, as it covered sizeable disadvantaged lower castes. On women empowerment, however, the results were mixed (Samantaraya and Goswami, 2015).

A study finds that after joining the women groups and receiving microcredit, there is a significant improvement in the economic situation of women in Kerala (Kumar, 2016). Another study shows a positive correlation between micro-finance and women empowerment (Maity, 2016). In addition, micro-finance activities have altered the living condition; and these activities have also

contributed to social women empowerment (Vachya, 2015).

Availability of local credit providers is strongly associated with faster growth for small and medium-size firms in sectors with growth opportunities, less likely for a firm to exit and more likely to invest (Fafchamps and Schündeln, 2013). Micro-finance programmes had a positive impact on the participating households. Poverty-reducing effects are observed on a number of indicators such as water supply and the quality of roofing and walls (Ghalib et al., 2015). Micro-finance also have impacted positively on rural economy. The full impact possibilities of these institutions as catalyst for rural development are yet to be realised *(Agbaeze and Onwuka, 2014)*.

Despite the successful and effective tool for poverty alleviation, several development specialists are also sceptical about microcredit's universal effectiveness (Wood, 1997; Weber, 2002). Households living in extreme conditions of poverty who possess minimal or no surplus financial capacity to cope with contingencies are susceptible to adverse effects of microcredit; and suggest ways to avoid microcredit borrowers falling victims to such unintended consequences (Jahiruddin, 2011). The increased targeting of women also has been criticised as exploitative (Lantican et al., 1996); and with an increasing trend of commercialisation of microcredit, and resulting obsession with regular debt repayment and profitability of microcredit projects, many scholars also blame microcredit practitioners of leaving out the poorest of the poor as non-prospective customers (Datta, 2004; Copestake, 2007).

Accessibility to credit is not sufficient for poverty reducing, which is efficiency only if poor households are provided better consultations and support not only from banks, but also from professional association in using capital (Tu et al., 2015). There is another support to complement microcredit. Households using microcredit in combination with micro-insurance develop significant gains in terms of welfare improvement. Microcredit possibly will be good, but its benefit to the poor is enhanced and sustained if the poverty trapping risks are covered with micro-insurance. To this extent, combining microcredit with micro-insurance will endow the poor to sustainably alleviate poverty (Akotey and Adjasi, 2015).

The fact that microcredit is to a large extent good for poverty alleviation, farmers do not immediately access available credit to enhance their livelihoods. There are many factors affecting farmers to access credit. Ghosh and Ray (2016) mention that information and loan enforcement play important roles in informal credit markets. In Vietnam, Tu et al. (2015) find that total land area per capita, residential area owned, total assets, average of education level are positive factors of accessibility to formal credit; meanwhile, average of education level affects the probability to receive and size of loan. Total owned land still is the key factor that affects ability to receive loans by the poor households. Indeed, formal lenders normally require land use certificate likely as collateral for loans. More educated households tend to either make business

plan efficiency than or gain information flow from formal credit (Khandker, 2003). Interest rate positively impacts the loan amount. More interestingly, rate of non-farm income and poor characteristics of household recognised by the locals are positive determinants of accessing preferential credit. Households with more assets are more likely to adopt fertilisers, but less likely to participate in the local credit market as they have better savings that could be used to purchase fertilisers/improved seeds without credit contract. This means that poorer farmers are heavily dependent on credit than the wealthier (Tadesse, 2014).

Indonesia undergoes a vicious circle of rural poverty because many poor people stay in rural areas and they are strongly dependent on agriculture. Based on the importance of microcredit in rural development, there is a series of problem statements as follows. The fact that microcredit has been available for Indonesian rural households, it has not been optimally utilised by farmers; and the fact that advanced technology in horticultural sectors have been introduced to farmers, the impact on farmers' welfare is still questionable. There must be a gap causing such problems. A research question raised to this study is: to what extent did microcredit play a significant role in cutting the vicious circle of rural poverty, along with advanced agricultural technology; and reversing the circle into virtuous circle that enhanced farmers' welfare.

Main objective of this study is to analyse the role of credit and technology in breaking up vicious circle of rural poverty. This objective can be decomposed into particular objectives: (1) to assess a virtuous circular causal relation between microcredit, technology and rural prosperity, (2) to determine factors affecting farmers to access microcredit and adopt technology, (3) to evaluate the impact of microcredit and technology on farmers' welfare.

Literature Review

In rural areas, agriculture is the main source of income for rural households. Improvements in agriculture help them to increase welfare. Adoption and widespread diffusion of agricultural technology are important components for the progress of farming, and rural development as such. This comes about in development and wider use of modern agriculture technology (Huang et al., 2004). Successful adoption of technology can be a powerful force in reducing poverty as agriculture sector has multiple effects on the whole economy and with more positive outcomes on reducing poverty and rural development process (de Janvry and Sadoulet, 2002). This is also considered as developmental impacts of farming. One of the most important determinants of the effectiveness of such impact is the level of adoption of technology and innovation and on their income (Griliches, 1957). This is consistent with the neoclassical theory of economic growth, where economic development depends only on capital stock, labour, and the level of technological progress.

Higher level of capital accumulation can only have a temporary effect on growth, while long-term growth is only supported by technological progress.

Innovation should be backed up with innovative research with its faster completion, widespread adoption by intended users, and higher turnover of benefits. A common problem, and also one of the very critical requisites for agricultural development process, is how to accelerate the rate of adoption over time (Rogers, 1995). Nevertheless, speeding up the rate of adoption of new technology requires knowledge of various factors that influence adoption decision of an individual member operating in a society with complex forces. One of the essential factors is financial support provided by financial institutions. Adoption of agricultural technology during the Green Revolution is one example of the important role of credit (Mariyono, 2015).

The importance of credit markets in economic growth has been hypothesised long time ago by Schumpeter (1911) who argued that business persons needed credit to finance the adoption of advanced technology. Credit providers were viewed as key agents in facilitating the flow of capital, and thus promote sustained economic growth. Development of a financial system is crucially important in stimulating economic growth because under-developed financial systems slow down economic growth (Gurley and Shaw, 1955; Goldsmith, 1969; and Hicks, 1969). Thus, policies to promote growth should expand the financial systems by creating more financial institutions and promoting greater variety of financial products and services to generate a positive effect on the saving – investment process, and hence on economic growth. Ferdousi (2015) shows that loan products are so far to play many roles to enhance innovation.

In spite of general acknowledgment of the central role of technological change and technology adoption in influencing economic growth, productivity and competitiveness, there is a lack of understanding on technological change in agriculture (Doss, 2006; Martin and Warr 1994; Feder et al., 1985). Technological change can be influenced by a variety of factors, but its determinants and actual process of technological change, taking in a place are still less understood topic in the literature of development economics. They are also some of the very widely discussed and debated public policy issues in the rural development sector.

Methodology

This study used a Structural Equation Modelling (SEM) as analytical tool. This tool is a very powerful multivariate technique that is a specialised version of analytical method and enables researchers to measure direct, indirect and total effects of variables on others. SEM also performs test models with multiple endogenous variables, using of several regression equations simultaneously (Alavifar et al., 2012). SEM is preferable to other usual methods because it reduces multicollinearity and bias (Tang and Folmer, 2016).

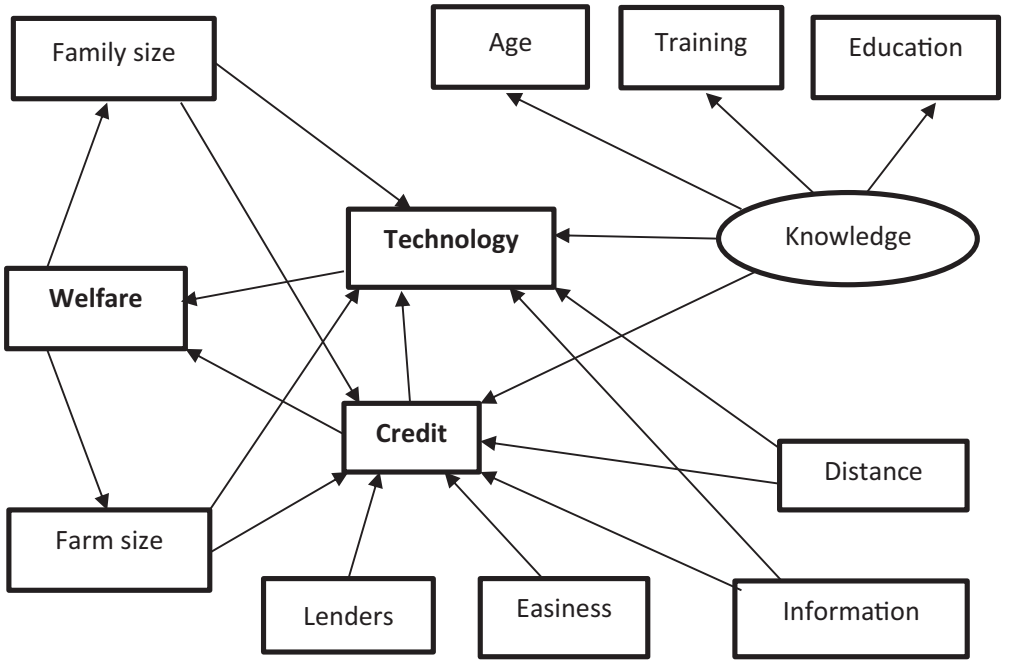

Figure 1: Analytical Model

A basic concept adapted in the study is what is called endogenous technological progress, where the adoption of advanced technology is induced within the system (Romer, 1990). In this case, the producers allocate a fraction of their achievement to increase firm size and family size. Further, with bigger farm and family, farmers are expected to adopt technology to increase welfare. If this is the case, there will be a loop of causal interrelation that enables farmers to sustain welfare improvement. The model of analysis is shown in Figure 1.

There is one latent variable called 'knowledge', which is constructed from age, education and training. Endogenous variables in this study are family size, farm size, welfare, technology and credit. Exogenous variables consist of number of information sources, distance of farming to market, credit accessibility and number of lenders. These variables have direct and indirect influences to endogenous variables. For example, distance to market affects technology adoption directly, and indirectly through mediation of accessing credit. This is also the case for endogenous variables that affect other endogenous variables both directly and indirectly. The resultant of indirect and direct effects is the total effect. For example, the effect of credit and technology on welfare can be represented in Figure 2. The

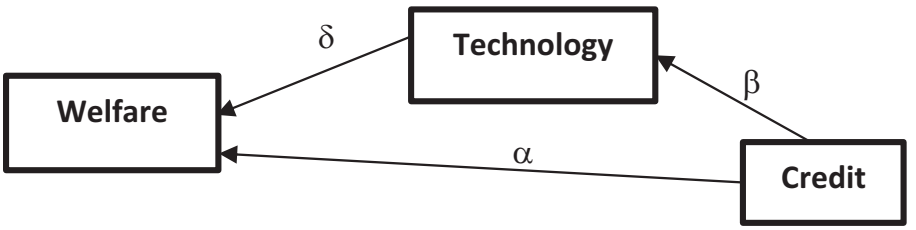

Figure 2: Direct, Indirect and Total Effects

direct effect of credit on welfare is *a*; the indirect effect of credit on welfare via mediation of technology is *b*×*d*; and the total effect is $a + b \times d$ (StataCorp, 2013).

The selection of such variables and analytical model are based on the previous research provided in the introduction. A series of hypotheses is tested at least with 90 per cent confidence interval. The null hypotheses have formulated that every path (represented by arrow) has no effect on corresponding variable. The estimated coefficient of each variable is presented in a standardised value, and thus it is comparable to one another.

Chilli is an important cash crop in Indonesia, which provides a significant contribution to the local and national economy. Its production uses about 20 per cent of the vegetable land and produces 12 per cent of the total vegetable output, with a low average yield than other vegetables in general (White et al., 2007). With adoption of the modern technology, chilli farming is expected to contribute more to the rural economy of Indonesia. That is a reason as to why this study is focused on chilli sector.

Java was selected for farm household survey because more than half of national production of chilli is produced in this island. Primary data were collected at farm level. Household level information was collected using personal interview with structured questionnaires, and group level qualitative data were collected from group discussion among farmers. Particular attention is paid to advanced technology including hybrid seeds, foliar fertilisers and silvery plastic mulching. Adoption of such technology has increased productivity of vegetable farming (Griliches, 1957; 1958; Baloch et al., 2008; Gul et al., 2009). The survey was conducted in 2013-2014. Number of samples purposively selected using stratified random sampling are 220 farmer households. Definition and measurement of variables are provided in Table 1, and summary statistics of such variables are presented in Table 2.

Table 2 shows that every variable has good variation, which is shown by relatively high standard deviation. The variations of such variables are expected to provide good estimates of relationships among variables as expressed in the analytical model.

Table 1: Definition and Measurement of Selected Variables

Variables	Definition	Measure
Endogenous Variables		
Welfare	Farmers' social status: 1= very poor, 2=poor, 3= medium, 4=rich, 5=very rich	scoring
Technology	Number of technology adopted by farmers	numeric
Credit	Whether or not farmers accessing credit for financing their farming	1=yes; 0=no
Farm size	Area of chilli cultivation	hectare
Family size	Number of family members in a household	numeric
Exogenous Variables		
Knowledge	Latent variable constructed by level of formal education, age and training programme	
Age	Age of household head	year
Education	Time (year) spent for formal education	year
Training	Number of trainings attended by farmers	numeric
Lenders	Number of credit providers accessible to farmers in each location	numeric
Easiness	Easiness of credit accessibility, 1=very difficult, 2=difficult, 3=fair, 4=easy, 5=very easy	scoring
Information	Whether or not farmers accessing market information applicable to their farming	1=yes; 0=no
Distance	Distance of farming to the market accessed by farmers	km

Source: Authors' analysis.

Table 2: Summary Statistics of Selected Variables

Variable	Obs	Mean	Std. Dev.
Welfare	220	2.186	1.141
Technology	220	1.104	1.311
Credit	220	0.209	0.408
Age	220	44.46	10.57
Education	220	7.632	2.805
Training	220	2.177	1.383
Farming size	220	5524	4145
Family size	220	4.114	1.261
Lenders	220	2.518	0.883
Easiness	220	2.882	1.312
Information	220	0.505	0.501
Distance	220	4.891	3.732

Source: Authors' analysis.

Results and Discussion

Significance of latent variable measurement is presented in Table 3. All variables significantly construct latent variable of knowledge. Age has negative sign, which signifies that older farmers are are not sumptously informed. Being old is likely to be less active in farming since chilli farming need drudgery, which is quite difficult for old farmers to operate in such farming conditions.

Table 3: Measurement of Latent Variables

Variable	Coef.	Robust s.e.	z-value
Education			
Knowledge	0.9651	0.2198	4.39a
Constant	2.7270	0.1303	20.92a
Age			
Knowledge	-0.4020	0.0903	-4.45a
Constant	4.2138	0.2073	20.33a
Training			
Knowledge	0.2513	0.0825	3.05a
Constant	0.4642	0.0411	11.30a

Source: Authors' analysis. Letter following z-value indicates significant level at: a) 1%, b) 5%, c) 10%, n) insignificant.

The main result of analysis is provided in Table 4. Rural welfare was significantly affected by technology and credit. Technology contributed more to rural welfare than credit. Technology lead to rural welfare because farmers gained more profit. To a small extent, credit has made possible to increase prosperity because it was used to finance activities other than agricultural practices.

Technology was significantly impacted by farm size, knowledge and credit. This is understandable because the credit was used to finance the technology. Farm size was the most important factor encouraging farmers to adopt technology. There was an incentive for farmers to adopt technology when they held larger farms. Knowledge played an important role in stimulating farmers to adopt technology. This is very logical that farmers with higher capacity were able to apply advanced technology. Other factors had no significant impacts.

Table 4: Estimated Structural Equation Model

Variables	Coefficient	Robust s.e.	Z-value
Welfare			
Technology	0.4200	0.0709	5.92a
Credit	0.0837	0.0515	1.62c
Constant	1.5194	0.1247	12.18a
Technology			
Family size	-0.0172	0.0645	-0.27n
Farm size	0.3803	0.0593	6.42a
Credit	0.1359	0.0622	2.18b
Distance	-0.0024	0.0555	-0.04n
Information	0.0348	0.0589	0.59n
Knowledge	0.1553	0.0667	2.33b
Constant	0.2855	0.2318	1.23n
Credit			
Family size	-0.0398	0.0307	-1.30n
Farm size	0.0147	0.0284	0.52n
Distance	-0.1066	0.0370	-2.88b
Information	0.0467	0.0328	1.42n
Lenders	0.5036	0.0759	6.63a
Easiness	0.4538	0.0739	6.14a
Knowledge	0.0940	0.0579	1.62b
Constant	-1.7151	0.1423	-12.06a
Farm size			
Welfare	0.2931	0.0728	4.03a
Constant	0.7739	0.2361	3.28a
Family size			
Welfare	0.1447	0.0685	2.11b
Constant	2.9926	0.2067	14.48a
Number of observations	220		
Log pseudolikelihood		-5914.99	

Source: Authors' analysis. Letter following z-value indicates significant level at: a) 1%, b) 5%, c) 10%, n) insignificant.

Credit was significantly affected by lenders and easiness, and the magnitude of both impacts was similar. This makes a lot of sense, because farmers have many alternatives in accessing credit. Further, with less complicated process in accessing credit, farmers were less reluctant to get credit. Credit was also significantly influenced by location of farm to market, where, the closer the farm is to the market, more likely will they have access to credit. This indicates that credit providers were still away from the location of farm. In this

case, the educated, skilled and young farmers made attempts to access credit. This is sensible because such farmers were expected to be more rational. They accessed credit to finance the technology.

There was a further impact on welfare. In this case, wealthier farmers are likely to expand their life. In this study, it can be forms of family size and farm size. More prosperous farmers significantly expanded their farm size. The expansion of farm size in the short run could be conducted by rented land for chilli farming and other crops. In the long run, it could be conducted by purchasing land when the fund from advanced technology has been accumulated. Rich farmers also significantly enlarged family size, which could probably be more of family members.

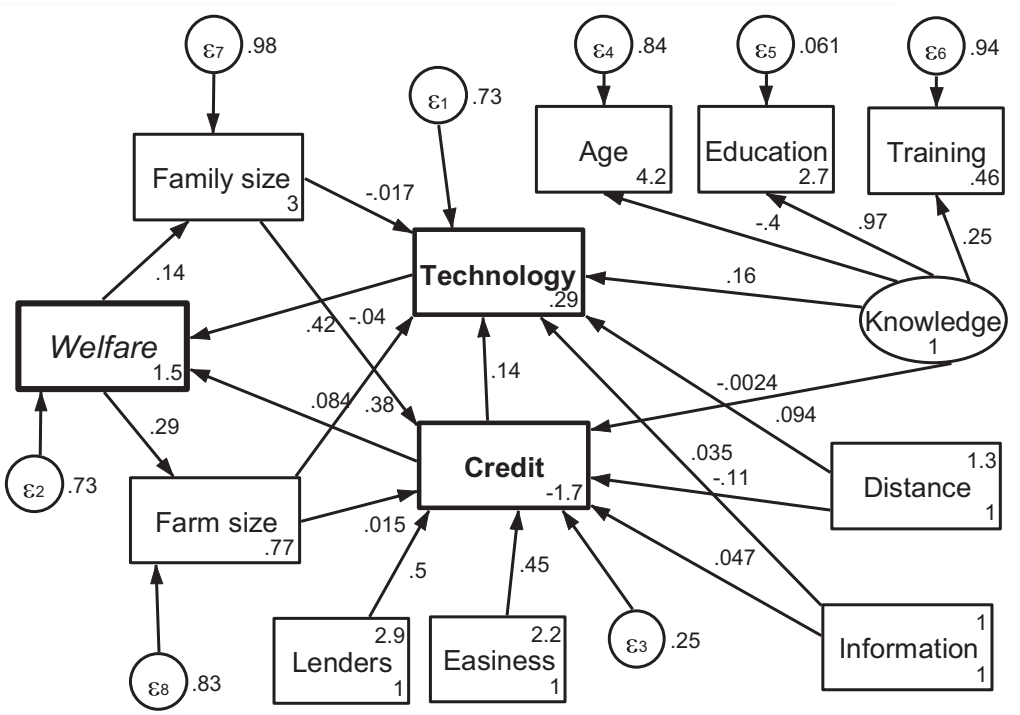

Figure 3: Estimates of Analytical Model

Previously, farm size significantly led to technology adoption, and the technology adoption significantly led to well-being. This circular-causal interrelations continues to happen, and the farming and prosperity continue to develop. This finding fits a concept of endogenous technological progress, where technology adoption is endogenously induced within farming system. Exogenous factors provide facilities to encourage farmers to adopt technology and innovation. As long as exogenous facilities are available, the process of technological progress can be endogenously sustained. This particular finding supports a sustained growth of chilli production in Indonesia (Mariyono and Sumarno, 2015). But, this is not the case with family size, where there was no impact of bigger family on technology and credit. The estimates of SEM are presented in Figure 3.

Figure 3 shows that each variable has both direct and indirect impacts, resulting in total effects on other variables. The magnitude of direct impact of each variable is presented by the number in each arrow; the indirect impact of each variable is a dot-product coefficients of mediating arrows; and the total effect of each variable is a summation of direct and indirect effects. The total effect of each variable is presented in Tables 5 to Table 9.[1]

Table 5 presents total effects of each variable on welfare. The top three factors that affect welfare are technology, farm size and credit. Total effect of technology was higher than that of accessing credit. It is clear that technology was the important factor in improving farmers' well-being. It could be the case that credit accessed by farmers was not only used for financing technology, but also for other purposes.

Table 5: Total Effects on Welfare

Variable	Coefficient	Robust s.e.	Z-value
Welfare			
Technology	0.4401	0.0767	5.74a
Welfare	0.0478	0.0159	3.01a
Family size	-0.0135	0.0292	-0.46n
Farm size	0.1696	0.0278	6.11a
Credit	0.1475	0.0597	2.47b
Distance	-0.0168	0.0263	-0.64n
Information	0.0222	0.0267	0.83n
Lenders	0.0743	0.0318	2.34b
Easiness	0.0669	0.0292	2.29b
Knowledge	0.0822	0.0164	5.02b

Source: Authors' analysis. Letter following z-value indicates significant level at: a) 1%, b) 5%, c) 10%, n) insignificant.

(Notes)

[1]Because the value direct impacts is the same as that reported in Table 4, the differences between direct and total impacts represent indirect impacts, which can be seen in appendices.

Table 6 shows total effects of variable on technology. The top three factors that encouraged farmers to adopt technology were welfare, credit and knowledge. It is justifiable that credit also gave the highest impact on technology adoption, which means that farmers adopt technology largely due to financial support of credit. This is consistent to the fact that farmers' welfare tended to adopt technology.

Table 6: Total Effects on Technology

Variable	Coefficient	Robust s.e.	Z-value
Technology			
Technology	0.0479	0.0083	5.74a
Welfare	0.1140	0.0375	3.04a
Family size	-0.0241	0.0689	-0.35n
Farm size	0.4008	0.0656	6.11a
Credit	0.1519	0.0663	2.29b
Distance	-0.0188	0.0586	-0.32n
Information	0.0435	0.0613	0.71n
Lenders	0.0765	0.0343	2.23b
Easiness	0.0689	0.0331	2.08b
Knowledge	0.1770	0.0111	15.95a

Source: Authors' analysis. Letter following z-value indicates significant level at: a) 1%, b) 5%, c) 10%, n) insignificant.

Table 7: Total Effects on Credit

Variable	Coefficient	Robust s.e.	Z-value
Credit			
Technology	-0.0006	0.0001	-5.74a
Welfare	-0.0015	0.0027	-0.56n
Family size	-0.0397	0.0310	-1.28n
Farm size	0.0145	0.0284	0.51n
Credit	-0.0002	0.0001	-2.47b
Distance	-0.1066	0.0378	-2.82b
Information	0.0466	0.0331	1.41n
Lenders	0.5035	0.0803	6.27a
Easiness	0.4537	0.0729	6.22a
Knowledge	0.0938	0.0516	1.82c

Source: Authors' analysis. Letter following z-value indicates significant level at: a) 1%, b) 5%, c) 10%, n) insignificant.

Table 7 shows total effects of the variable on credit. Credit was greatly affected by number of lenders and easiness of accessing credit. Farmers were willing to access credit due to accessibility of credit and availability of credit providers in the local market. Knowledge also played a significant role in accessing credit, where educated, trained and young farmers tended to access credit in order to pay for technology applicable to chilli farming.

Table 8 and Table 9 show total effects of factors affecting farm size and family size, respectively. Farm size and family size were substantially affected by welfare and technology. This means that farmers allocated a significant portion of profit to enlarge their business and family.

Table 8: Total Effects on Farm Size

Variable	Coefficient	Robust s.e.	Z-value
Farm size			
Technology	0.1290	0.0225	5.74a
Welfare	0.3071	0.0991	3.10a
Family size	-0.0039	0.0086	-0.46n
Farm size	0.0497	0.0081	6.11a
Credit	0.0432	0.0175	2.47b
Distance	-0.0049	0.0077	-0.64n
Information	0.0065	0.0082	0.79n
Lenders	0.0218	0.0108	2.02b
Easiness	0.0196	0.0099	1.99b
Knowledge	0.0241	0.0089	2.72b

Source: Authors' analysis. Letter following z-value indicates significant level at: a) 1%, b) 5%, c) 10%, n) insignificant.

Table 9: Total Effects on Family Size

Variable	Coefficient	Robust s.e.	Z-value
Family size			
Technology	0.0637	0.0111	5.74a
Welfare	0.1516	0.0671	2.26b
Family size	-0.0019	0.0042	-0.46n
Farm size	0.0245	0.0040	6.11a
Credit	0.0214	0.0086	2.47b
Distance	-0.0024	0.0037	-0.65n
Information	0.0032	0.0042	0.76n
Lenders	0.0108	0.0067	1.60n
Easiness	0.0097	0.0062	1.57n
Knowledge	0.0119	0.0062	1.93b

Source: Authors' analysis. Letter following z-value indicates significant level at: a) 1%, b) 5%, c) 10%, n) insignificant.

Conclusion and Policy Implication

Majority of the Indonesian people stay in rural areas, where a chronic problem of vicious circle of poverty exists. The fact that agriculture is the main source of income in rural areas demands improvement in agricultural practices to make rural people's life better. Improvement can be possible by introducing advanced technology. Adoption of such technology is expected to provide higher productivity and efficiency of farm and generate more income to farmers. Eventually, with such technology, farmers' welfare will increase. However, it is unlikely for farmers to adopt the technology without additional supports. This is because the technology is more expensive and sophisticated to apply than the conventional one.

Using structural equation modelling based on data of a farm survey, the vicious circle of rural poverty was broken up by adoption of technology, supported by microcredit and other factors, and it changed into a virtuous circle that escalated welfare of farmers. The role of microcredit was very important because it was used for financing the technology. Without microcredit, it was unlikely for farmers to adopt technology. Technology adoption was also strengthened by farmers who had made investments, resulting from better profit. Note that farmers would access credit if the credit providers were close to the farms. Simple bureaucracy of credit also would encourage farmers to utilise microcredit. Advanced technology was more likely to be adopted by young, skilled and formally educated farmers. The virtuous circle guarantees to sustain rural economic development as long as the exogenous factor exists.

Based on this finding, policymakers should introduce more advanced technology and provide farmers with credit facilities at the same time to ensure sustained technology adoption that increase rural prosperity. Number of credit providers should be enough at farmers' community, and procedure of administrative process of accessing credit should be straightforward.

Appendices

Partial Correlation among Variables

Variables	Partial	Semi-partial	Partial	Semi-partial	Significance
Prosperity	Corr.	Corr.	Corr.^2	Corr.^2	Value
Technology	0.0985	0.0847	0.0097	0.0072	0.1558
Credit	0.1957	0.1708	0.0383	0.0292	0.0045
Age	-0.0369	-0.0316	0.0014	0.0010	0.5956
Education	-0.1418	-0.1226	0.0201	0.0150	0.0406
Training	-0.0280	-0.0240	0.0008	0.0006	0.6872
Farm size	0.4249	0.4017	0.1806	0.1614	0.0000
Family size	0.0464	0.0397	0.0022	0.0016	0.5048
Lenders	-0.0848	-0.0729	0.0072	0.0053	0.2219
Easiness	-0.1055	-0.0908	0.0111	0.0082	0.1286
Information	0.0118	0.0101	0.0001	0.0001	0.8649
Distance	-0.0128	-0.0109	0.0002	0.0001	0.8542

Source: Authors' analysis.

Indirect Effects of Factors on Others

Variables	Coef.	Robust s.e.	P	P>Z
Welfare				
Technology	0.0203	0.0035	5.74	0.000
Welfare	0.0484	0.0157	3.09	0.002
Family size	-0.0064	0.0289	-0.22	0.823
Farm size	0.1665	0.0275	6.05	0.000
Credit	0.0636	0.0278	2.29	0.022
Distance	-0.0167	0.0265	-0.63	0.525
Information	0.0217	0.0267	0.81	0.415
Lenders	0.0736	0.0315	2.34	0.019
Easiness	0.0667	0.0291	2.29	0.022
Knowledge	0.0827	0.0164	5.04	0.000
Technology				
Technology	0.0484	0.0084	5.74	0.000
Welfare	0.1155	0.0374	3.09	0.002
Family size	-0.0007	0.0032	-0.22	0.823
Farm size	0.0183	0.0030	6.05	0.000
Credit	0.0161	0.0066	2.46	0.014
Distance	-0.0163	0.0093	-1.75	0.080
Information	0.0084	0.0064	1.30	0.195
Lenders	0.0763	0.0342	2.23	0.026
Easiness	0.0692	0.0332	2.08	0.038
Knowledge	0.0222	0.0113	1.97	0.048

(Contd.....)

Appendices 2 (Contd.....)

Family size				
Technology	0.0605	0.0105	5.74	0.000
Welfare	0.0067	0.0022	3.09	0.002
Family size	-0.0009	0.0040	-0.22	0.823
Farm size	0.0229	0.0038	6.05	0.000
Credit	0.0202	0.0082	2.46	0.014
Distance	-0.0023	0.0035	-0.65	0.518
Information	0.0030	0.0040	0.74	0.462
Lenders	0.0101	0.0064	1.59	0.111
Easiness	0.0092	0.0059	1.56	0.118
Knowledge	0.0114	0.0062	1.85	0.064
Farm size				
Technology	0.1299	0.0226	5.74	0.000
Welfare	0.0143	0.0046	3.09	0.002
Family size	-0.0019	0.0085	-0.22	0.823
Farm size	0.0492	0.0081	6.05	0.000
Credit	0.0433	0.0176	2.46	0.014
Distance	-0.0049	0.0077	-0.64	0.524
Information	0.0064	0.0082	0.78	0.436
Lenders	0.0218	0.0108	2.01	0.045
Easiness	0.0197	0.0100	1.98	0.048
Knowledge	0.0245	0.0090	2.73	0.006

Source: Authors' analysis.

Pearson Correlation among Variables

		Variables										
	Variables	1	2	3	4	5	6	7	8	9	10	11
1	Welfare	1										
2	Technology	0.1351	1									
3	Credit	0.1416	0.2077	1								
4	Age	0.0579	-0.1347	-0.1622	1							
5	Education	-0.0655	0.2987	0.1835	-0.389	1						
6	Training	0.0704	0.036	0.054	-0.0292	0.2439	1					
7	Farm size	0.4338	0.0999	-0.0857	0.1309	0.0313	0.1862	1				
8	Family size	0.1312	0.0628	-0.1086	0.0885	-0.0359	0.0811	0.2342	1			
9	Lenders	0.0396	0.05	0.7629	-0.0808	0.0681	-0.0568	-0.1007	-0.0613	1		
10	Easiness	0.027	0.123	0.7552	-0.0793	0.1122	0.0055	-0.0994	-0.094	0.5692	1	
11	Information	0.0344	0.1275	0.0624	-0.0956	0.058	-0.0161	-0.0009	0.0606	-0.0053	0.0217	1
12	Distance	-0.0241	-0.0506	-0.1621	0.1427	-0.0619	-0.0951	0.0901	0.0444	-0.0188	-0.0847	-0.0583

Source: Authors' analysis.

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