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Extension Service and Farm Productivity in Nepalese Agriculture

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Abstract

Agriculture extension services have been recognized as a complementary input for increasing farm productivity. Nepal has developed wide network of agriculture extension service over the last two decades. We examine the impact of agriculture extension service on farm productivity in Nepalese agriculture using a switching regression model. Using a panel data set obtained from the two waves of Nepal Living Standard Survey, we find that there is a significant difference in the farm productivity between the farmers who receive the extensive service and those who do not. Despite the benefits of agriculture extensive service, we identify underutilization of the available services as one of the major problems of extension service in Nepal.

Key Words: Agriculture Productivity, Nepalese Agriculture, Extension Service

1. Introduction

Agriculture plays a primary role in the economy for most of the least developed countries (LDCs) in terms of both growth/share of the economy and development strategy of the country (Sadoulet and de Janvry 1995). A high and sustained rate of growth in agricultural productivity, therefore, can be considered as a necessary condition for achieving overall economic development of the LDCs. Nepal is an LDC, where three-fourths of the total population is directly engaged in the agricultural sector (ILO, 2014)[1]. Although the agriculture sector provides income and employment for more than 80 per cent of the people of the country (NPC 2007), its contribution to the GDP is only 36.4 per cent for the period 2001-2006 (MoF 2008)[2], indicating the lower productivity of Nepalese agriculture compared to other sectors of the economy. In particular, productivity of rice in Nepal, the major crop of the country, is lowest in South Asia and East Asia region (FAOSTAT, 2004 cited in Alauddin, and Quiggin, 2008).

A very few studies have attempted to explain the factors underlying the low agriculture productivity in Nepal. ADB, DIFID, and ILO (2009) and Adhikari (2008) identify lack of irrigation facilities and heavy dependence on rainfall as the major contributors of low productivity of Nepalese agriculture. Similarly, Ahmed (1994) reports an inadequate use of fertilizers that, on average, only 16 percent of the prescribed amount of fertilizers have been used and suggests for an increasing fertilizer consumption to enhance the agriculture productivity in Nepal. More recently, Agriculture Perspective Plan (APP) of Nepal has laid emphasis on irrigation, agricultural road and fertilizer use for taking benefit from agriculture sector through increasing productivity (DGL, NARMA, SEEPORT, 2006). Adhikari (2008) finds, among others, poor access to the market and increasing role of unregulated middleman discouraging farmers to take risk for increasing productivity.

Nishimizu and Page (1982) decompose productivity growth into technological change and technical efficiency. Technological change is achieved through investment in research and

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[1] In terms of share of employment in agriculture sector. 73.9 % of labor force are employed in agriculture and forestry sector.

[2] Calculated from the data given in the Economic Survey.

technology while technical efficiency is a result of education, training, and experience (Bravo-Ureta, 2002). Consequently, agriculture productivity growth depends not only on increasing modern input use but also on research and extension services. The major objective of agriculture extension is to enhance farmers' knowledge about crops and cropping pattern (Feder, Lau and Slade, 1987). Agriculture extension complements the use of inputs such as high yielding varieties of seeds, fertilizer, pesticides/insecticides, etc. (Mellor, 1976). Several studies have been carried out in different context to support the idea of positive impact of agriculture extension on farm productivity (Evenson, 2001; Birkhaeuser et al., 1991).

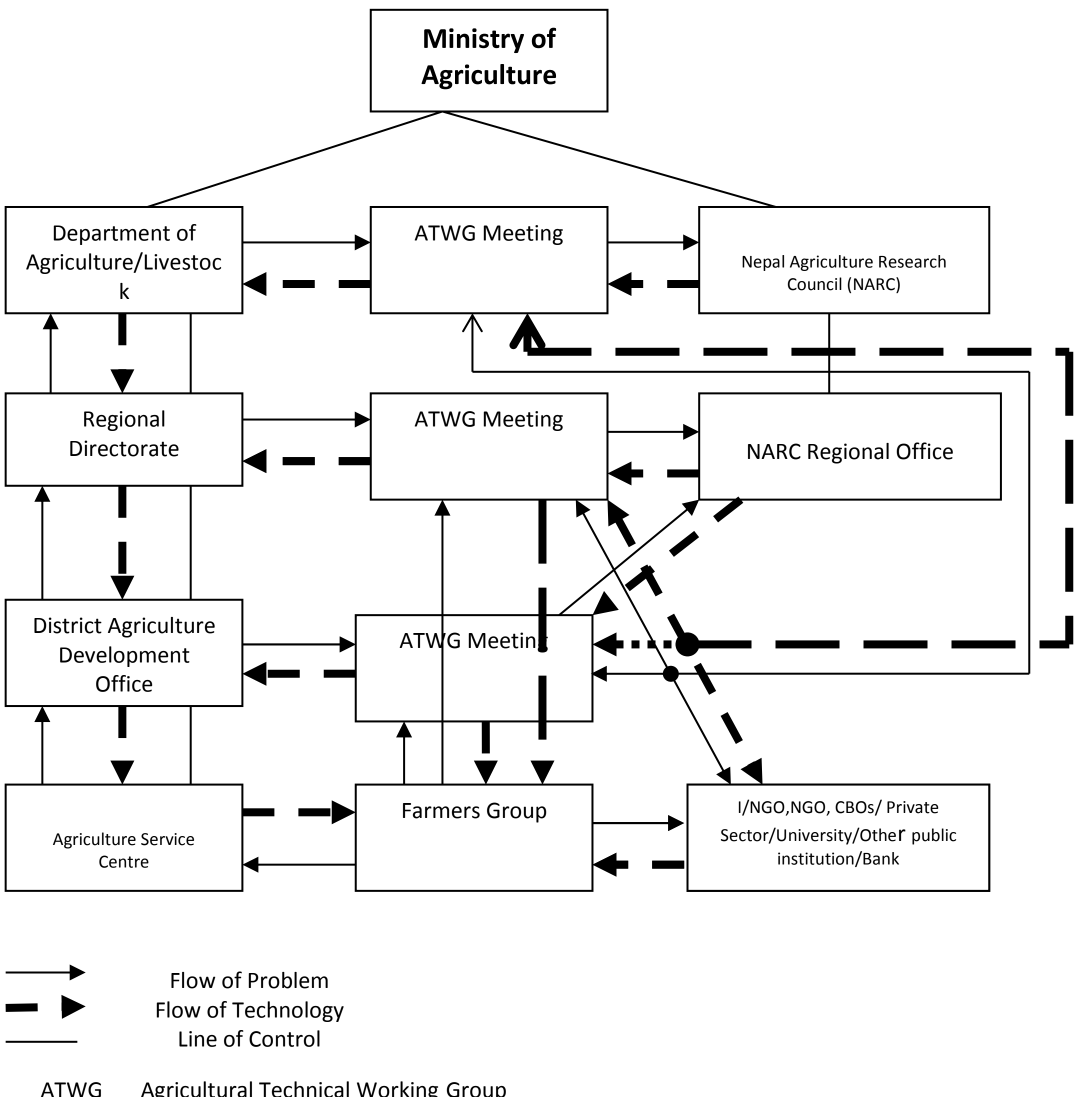
The major objective of this paper is to analyze the impact of research and extension on paddy productivity of Nepal using panel data. More specifically, we attempt to estimate the difference between the rice production per hectare of land by farmers who received government agricultural extension service and by those who did not. Rest of the paper proceed as follows: next section highlights the situation of agriculture extension service in Nepal followed by methodology in section three, data and study area are discussed in section four followed by results and discussion in section five, and conclusion in section six.

2. Agricultural Extension Service in Nepal

Agriculture extension services in Nepal are mainly administered by the Department of Agriculture (DoA). District Agriculture Development Office (DADO) and 378 Agriculture Service Centre are the basic units of extension. The approaches adopted for agriculture extension in Nepal are (Sharma and Bhandari, 2005): (i) **Conventional Educational Approach** in which key farmers play major role in the process of motivation and education (ii) **Pocket Package Approach** in which project is developed for certain crop in the feasible pockets selected (iii) **Projectization Approach** in which commodity based production program is implemented on the basis of project designed within the framework of time duration, budget expenditure and expected output. (iv) **Farmers Group Approach** in which a group of farmers with similar interest is formed and all extension activities are carried out in group basis. (v) **Farmers Field School Approach** is especially popular in Integrated Pest Management Program (IPMP) and (vi) **Partnership Approach** in which all relevant stakeholders including I/N/GO, CBO, farmers, private sector, universities are brought into partnership for research and extension in agriculture sector of Nepal. Fig 1 shows the network of different stakeholders for agriculture research and extension in Nepal.

Fig 1 shows that technology developed through different institutions, as explained earlier, are passed on to the farmer through developer themselves or through DADO and ASC. Similarly, problems faced by farmers in their farm are transmitted to researchers through DADO and ASC or direct interaction of research institution with farmers.

Fig 1: Agriculture Research and Extension Network in Nepal.



Source: Based on explanation available in AED (2008).

3. Methodology

Birkhaeuser, Evenson and Feder (1991) provide review of several studies on impact of extension on farm productivity. Based on the level at which productivity and extension are incorporated into the econometric model, they classify the models into three categories: (i) both productivity and extension service variables are measured at farm level (ii) productivity variable is measured at farm level but extension variable is at regional or village level (iii) both productivity and extension service variables are measured at regional or village level. The review also highlights that most of the studies suffered from selection bias problem.

Consider the naïve regression model $y_{ijt} = \gamma\, x_{ijt} + \beta\, z_{ijt} + e_{ijt}$ where y_{ijt} is the agriculture output for farm *i* of locality *j* at time *t*. x_{ijt} is some measure of extension variable and z_{ijt} is the vector of control variables. In this model, selection bias arises if more skilled farmer is likely to receive more extension service or extension officers prefer to visit such farmers in comparison to less skilled one (Owens, Hoddinotty and Kinseyz, 2001).

We follow the econometric model developed by Guirkinger and Boucher (2008) partly to avoid the problem of selection bias and partly due to the similar nature of data and problem. Guirkinger and Boucher (2008) analyze the impact of credit constraint on farm productivity for Peruvian agriculture by using panel data. This study, as explained earlier, discusses the impact of agriculture extension service on farm productivity for Nepalese agriculture by using panel data. Particularly, we use Switching Regression to estimate the impact of agriculture extension service, defined as the technical advice taken from Government Agriculture Technician over the past 12 month at the time of survey, on farm productivity. The analysis proceeds by evaluating whether or not farm productivity and productive endowments differ across farm households receiving and not receiving agriculture extension service by using following switching regression model.

$$y_{it} = \begin{cases} y_{it}^{e} = \beta^{e'} X_{it} + \alpha_i^{e} + \varepsilon_{it}^{e}, & \text{if } d_{it} = 1 \\ y_{it}^{ne} = \beta^{ne'} X_{it} + \alpha_i^{ne} + \varepsilon_{it}^{ne}, & \text{if } d_{it} = 0 \end{cases} \qquad \ldots (1)$$

In equation (1), say productivity equation, y_{it} is the observed farm productivity which is equal to either productivity with agriculture extension service $\left(y_{it}^{e}\right)$ or without extension service $\left(y_{it}^{ne}\right)$ depending on whether the farm household utilizes the technical advice from government agriculture technician or not. X_{it} is the vector of time varying factors that determines productivity, α_i^e and α_i^{ne} are time invariant unobserved factors that affect productivity, and ε_{it}^{e} and ε_{it}^{ne} are error terms with zero mean and no correlation with X_{it}.

Equation (2), also known as selection equation, describes farmer's decision to utilize technical advice from government agriculture technician.

$$d_{it}^{*} = \sigma' Z_{it} + \eta_i + \nu_{it}$$
$$d_{it} = \begin{cases} 1, \text{ if } d_{it}^{*} > 0 \\ 0, \text{ if } d_{it}^{*} \le 0 \end{cases} \quad \ldots (2)$$

Here, d_{it}^{*} is a continuous latent variable that determines the propensity of household to utilize the agriculture extension service. d_{it}^{*} is a linear function of time varying factors Z_{it}, time invariant unobserved household characteristics η_i, and time variant unobserved factors ν_{it}. d_{it}^{*} is not directly observed, what a researcher observes is only whether the household took the service from extension officers or not (d_{it}). d_{it} is a binary variable which takes value 1 if d_{it}^{*} exceeds some threshold value set at zero, indicating a particular household which takes agriculture extension service. If household does not take such service then d_{it} takes value 0.

Obtaining unbiased estimate of β is obstructed by two factors (Guirkinger and Boucher, 2008). First, the possible non-zero correlation between household fixed effects, α_i^e and α_i^{ne}, and any other observable time varying factors that determine productivity. For example, if a household is residing in the vicinity of forest area (*fixed effect)* then the quality of land (*factors determining productivity)* will improve every year due to organic manure that the household will use in the land. Second, non-random selection process can lead to a non-zero correlation between unobservable factors and regressors in both sub-samples, utilizing and not utilizing agriculture extension service.

The above mentioned problem can be resolved by estimating fixed effect models accounting for both productivity. However, if $\text{cov}(\eta_i + \upsilon_{it}, \varepsilon_{it}) \neq 0$ then there will be what Carter and Olinto (2003) termed, "residual selection bias". The problem of "residual selection bias" can be resolved by using ether parametric technique of Wooldridge (1995) or semi-parametric technique of Kyriazidou (1997). Due to the strong assumption of normality in Wooldridge (1995) approach, Guirkinger and Boucher (2008) suggest to use Kyriazidou (1997) approach in the following two steps.

First estimate the parameters of the selection equation with a fixed effect logit model and predict propensity to use agriculture extension service. Use this predicted propensity to generate a weight for each household using a kernel density function. Then, use these weights for estimating first difference of each productivity equation using weighted OLS.

Once the two productivity equations are estimated, the efficiency loss due to not receiving extension service can be computed by using following equation.

$$\hat{\Delta}_{it} = (\hat{y}_{it}^{e} - \hat{y}_{it}^{ne}) = (\hat{\beta}^{e} - \hat{\beta}^{ne}) X_{it} \qquad \ldots (3)$$

4. Data and Descriptive Statistics

This study uses the panel data obtained from two living standard surveys of Nepal, namely Nepal Living Standard Survey I and II which were conducted on year 1996 and 2004 respectively. Nepal Living Standard Survey is nationally representative survey. Cross sectional sample sizes for survey I and II are 3615 and 3912 and panel sample size is 962. However, due to random missing values for all variables, less than 962 observations are used for the analysis.

This paper uses 35 crops (10 types of cereals, 11 types of pulses and legumes, 5 types of tuber and bulb crops, 5 types of oilseed crops, and 5 types of cash crops) to measure the value of total product. Market price for each crop is determined as the mean selling price of that crop in each primary sampling unit (PSU) of the data collection. The total value of crops produced by a household is thus the product of total harvest and respective price. Other variables for the analysis have been chosen following Antle (1983). Table 1 provides the variables used in the analysis of this study.

Table 1: Variables and their descriptions

Variables	Description of Variables
prod	Value of total crop production per acre measured in 2004 price (in NRs 1000).
age	Age of the household head.
agesq	Square of the age of the household head.
gender	Gender of household head (1=male, 0=female)
year_edu	Numbers of years of household head's education
tlu	Tropical livestock unit. All the livestock are converted into *tlu* using conversion factors available in Jahnke et al.(1988).
fert_exp	Total fertilizer expenditure in 2004 price.
irrig	Total irrigated land in acres
extension	If the household has used the extension service or not. Extension service is defined as the consultation with government affiliated agriculture technician. If a household has taken such service the *extension* takes value 1, otherwise it is zero.

Table 2a: Descriptive Statistics for the Variables Used in Analysis-Year 1996

Variable	Obs	Mean	Std. Dev.	Min	Max
prodvalue	766	13.97	26.40	0	261.69
age	792	44.03	14.32	15	86
agesq	792	2143.51	1389.77	225	7396
gender	792	0.87	0.34	0	1
year_educ	792	1.92	3.47	0	22
tlu	792	3.96	3.43	0	31.1
fert_exp	792	1007.90	2690.44	0	44304.89
land_irrig	792	0.37	1.21	0	17.95
extension	783	0.04	0.21	0	1

Table 2b: Descriptive Statistics for the Variables Used in Analysis-Year 2004

Variable	Obs	Mean	Std. Dev.	Min	Max
prodvalue	751	7.25	14.24	0	247.91
age	784	48.63	13.63	14	86
agesq	784	2550.47	1395.73	196	7396
gender	784	0.81	0.39	0	1
year_educ	784	2.15	3.62	0	17
tlu	784	3.65	2.97	0	22.7
fert_exp	784	1247.78	2506.53	0	32600
land_irrig	784	0.33	0.69	0	6.54
extension	772	0.06	0.24	0	1

Table 2c: Descriptive Statistics for the Variables Used in Analysis-Pooled

Variable	Obs	Mean	Std. Dev.	Min	Max
prodvalue	1517	10.64	21.53	0	261.69
age	1576	46.32	14.16	14	86
agesq	1576	2345.96	1407.09	196	7396
gender	1576	0.84	0.37	0	1
year_educ	1576	2.03	3.55	0	22
tlu	1576	3.80	3.21	0	31.1
fert_exp	1576	1127.23	2602.52	0	44304.89
land_irrig	1576	0.35	0.98	0	17.95
extension	1555	0.05	0.22	0	1

Table 2a-2c provide the description statistics of the variables. It is worth noting that even though the fertilizer expenses and total irrigated land has declined, the mean production per household has decreased from by about fifty percent from the year 1996 to 2004.

5. Estimation and Result

The regression result for the selection equation is shown in the Table 3.

Table 3: Estimation of Selection Equation

extension	Coefficient
gender	1.447
	(1.357)
age	0.0300
	(0.152)**
agesq	-0.004
	(0.002)**
dist_agcent	0.005
	(0.014)
year_educ	0.026
	(0.112)
fert_exp	0.0003
	(0.0002)*
land_irrig	-0.565
	(0.370)
No. of Obs	116
LR Chi-Square	17
Prob> Chi-Square	0.03

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Standard errors in parenthesis.

The result shows that the probability of taking extension service is determined by age of the household head and if the household is using fertilizer. Nepalese farmer who are mostly illiterate (mean years of schooling is about two years) are not confident about the required quantity of fertilizer. However, they are found to be aware that the wrong combination of fertilizer mix can harm the crops. This might be the reason that farmers using fertilizer consider accepting extension service.

Table 4 and 5 show the factors determining agriculture productivity for those who utilized the benefit of extension service in both periods and for those who did not.

Table 4: Weighted Least Square for Households with Extension Service in the both Period

extension	Coefficient
dage	-32.857
	(10.031)**
dagesq	0.117
	(0.044)*
dtlu_acre	14.420
	(5.006)*
dfertexp_acre	0.004
	(0.002)
dirrig_acre	-22.105
	(34.856)
dyear_educ	9.216
	(11.400)
constant	172.001
	(62.170)*
No. of Obs	10
R-Square	0.844
Prob> F	0.114

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. *Standard errors in parenthesis.*

Table 5: Weighted Least Square for HHs with No Extension Service in the both Period

extension	Coefficient
dage	-0.199
	(1.224)
dagesq	0.0.003
	(0.012)
dtlu_acre	1.138
	(0.023)***
dfertexp_acre	0.008
	(0.000)***
dirrig_acre	2.368
	(13.594)
dyear_educ	1.394
	(0.843)*
constant	-16.973
	(4.700)***
No. of Obs	545
R-Square	0.9368
Prob> F	0.000

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. *Standard errors in parenthesis.*

Numbers of factors contributing productivity with significant coefficient (i.e. *dtlu_acre*) is large for the group of farmers with extension service in comparison to those without extension service. Major contributor to productivity for both groups of farmers is the numbers of livestock units per acre of land.

The number of farmers receiving extension service is very small. Although there is wide network for agriculture research and extension service available, farmers seem to be indifferent in utilizing the service. Data shows that only 5.57 percent people took advice from government agriculture technician, and 77.71 percent of the households who did not take such advice, felt that there is no need for such services. There are two plausible reasons for which the farmers are not attracted towards using the extension services. First, either the current extension service is of lower quality in that it does not help farmers to increase their income or it is too costly for the farmers to follow the advice. While benefits of extensive service cannot be regarded futile by itself, the inability of the government's agriculture technicians to follow up on a regular basis is considered one of the major weaknesses of the program as farmers do not seem to be interested in taking one time service. Similarly the cost of implementing modern agricultural techniques based on experts' advice is too high for the small scale farmers to be able to compete in the market because of the availability of cheaper farm products produced in the nearby Indian market.

Second reason attributable to the lack of farmers' interest in participating the extensive service is its inaccessibility within the close proximity of farmland. Based on the responses of the sample household in NLSS II, 12.74 percent admitted that they did not take such service because of the distance they had to travel to get to the nearest agriculture center. According to the data from NLSS II, only 32 percent of households in Nepal can reach the nearest center in 30 minutes or less. This percentage was only 24.5 in NLSS I.

Finally, we estimate the difference in the productivity to provide the effectiveness of extensive services in Nepalese agriculture. The farmers receiving extensive services are able to produce 2352kg paddy per hector more than those not receiving it. This indicates that the extensive services have positive impact on the productivity despite the limitation of the current services.

6. Conclusion

Although most of the scholarly analyses about impact of extension service on farm productivity display positive impact of the former on the latter, it is not always necessarily the case. Agriculture extension service bridges the gap between level of available technology and the technology adopted by farmers. If farmers are already using superior level of available technology then extension service may not have positive impact on farm productivity (Dean, Evenson, and Feder, 1991). The current analysis of Nepalese case shows that there is significant impact of extension service on farm productivity. The major concern, here, is that only a very few farmers are reaping the benefit of extension service.

Exposing the benefits realized in increasing productivity is a necessary but not sufficient step toward inducing more farmers to utilize the extension service. Many Nepalese farmers face problems of access to market due to poor infrastructure (roads, bridges, etc). Under such circumstances, it will be a very challenging task to motivate farmers on utilizing the extensive services when they cannot take advantage of the increased productivity. Hence, in order to increase the growth of Nepalese agriculture, the government should focus on the expansion of extension service coverage coupled with the improvement in the infrastructure and access to market.

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