LABOR EMPLOYMENT IN VEGETABLE SEED PRODUCTION IN THE EASTERN HILLS OF NEPAL*

Prahlad K. Thapa
Vegetable Development Directorate, Khumaltar, Lalitpur, Nepal

Agnes C. Rola
Institute of Strategic Planning and Policy Studies, CPA, UPLB, Philippines

ABSTRACT

It has been reported that farmers opt vegetable seed production to give employment to underemployed family labor. If so, then how does it compare with the other competing crops? This information is needed to identify the relative importance of the crops in generating employment. This study has attempted to bridge these information gaps in the contractual vegetable seed production program in Nepal. Labour employment pattern was evaluated in terms of total employment and simultaneously determined male and female labour employment models. It was found that variables like manure, staking and irrigation, and bullock were positively significant in determining total labor employment per ropani. The price of labor was negatively significant. A significantly lower level of employment was also found when micronutrient deficiency appeared on the standing crop. The results of the simultaneous model show that male and female labor employment were not substitutes of each other but were rather complementary. It implies that employment of both types of labor was simultaneously increased in the production program. In the labor-surplus subsistence farming, the marginal value product of labor did not determine the use of labor. This implies that the study area is mainly characterized by subsistence farming. The labor employment ratio between competing crop and vegetable seed production was 1:1.63 and 1:5.33 for family and hired labor, respectively. This reflects the role of vegetable seed production in helping to alleviate under- and unemployment problems in the rural area.

INTRODUCTION

The Problem

Nepal has to achieve higher production of vegetables through increased productivity, as there is no possibility of bringing additional land under cultivation to increase production. The major increase in production is expected to be achieved through the increased use of locally produced improved seeds of high-yielding varieties. From the view point of climatic requirements of vegetable seed production, Nepal can produce almost all types of vegetable seeds because there is a wide range of agro-climatic conditions suitable for different types of vegetable seed crops at different places and times. Since the vegetable seed production program started almost two decades ago, potential seed production pockets with respect to a particular vegetable crop and/or variety have been identified. Farmers in the identified pockets have already gained experience in seed production. In addition, seed traders have also gained knowledge about the seed production pockets and the experienced farmers.

---

* This article is based on the Ph.D. dissertation of Prahlad K. Thapa submitted to the Graduate School, University of the Philippines under the guidance of Agnes C. Rola.

Despite all these, this question remains unanswered: why can vegetable seed production not expand in Nepal as expected? Several reasons are brought forward. Seed growers say that procurement prices are generally too low and that seed traders often do not honor the production contracts (Werner, 1995:45). Growers have also complained about traders' ill intention to reduce the price of the seed (Singh, 1996:17). Such behaviour discouraged seed growers from getting more involved in seed growing as vegetable seeds have almost no alternative use, in case the seed is left unsold. On the other hand, seed traders say that the government's current practice of fixing the procurement price of seeds in its program is a serious obstacle to the promotion of a free seed market in the country. In practice, such prices have been taken as the ones prevailing in the market, setting a bad precedent (Shrestha and Adhikari, 1996:3). India offers stiff competition. The procurement price of seeds in Nepal is so high that they cannot compete with Indian seeds (Shrestha and Adhikari, 1996:3). Seed traders also complain about the low-quality seeds and oftentimes the delivery is late (Singh, 1996:60).

The claims of both parties have no real basis. No policy options can be developed on the basis of such ad hoc recommendations. If seed production is not profitable, then why do farmers still participate in the program? If it is for the purpose of giving regular employment to family members, then how does it compare with the other competing crops? This information is needed to identify the relative importance of the crops in generating employment. This study has attempted to bridge these information gaps in the contractual vegetable seed production program in Nepal.

Objectives of the Study

This study aimed to examine the labor employment pattern and its determinants in vegetable seed production in the Koshi Hill Region of Nepal.

METHODOLOGY

Total Labor Employment

To examine the importance of the seed production program in rural employment generation, the study aimed to find the determinants of labor employment separately for total labor employment and the employment of female versus male labor. Total labor employment is a function of all production function variables in the particular crop production. Following similar studies (APROSC, 1983; Shah, 1980; Essang and Oben, 1975; Staub, 1973), the total labor employment model in this study is specified as

$$L_T = a_0 + a_1 \text{Ptol} + a_2 \text{Mq} + a_3 \text{Fv} + a_4 \text{Si} + a_5 \text{Pt} + a_6 \text{Bd} + a_7 \text{Fsr} + a_8 \text{Tp} + a_9 \text{Mn} + e_L \quad (1)$$

where L_T = total labor employed , Ptol = price of labor (weighted for male and female), Mq = quantity of manure applied (bhari[1]), Fv = expenses on all fertilizers (rupees[2]), Si =

1. bhari = full load of manure in a bamboo basket which weighs about 20 kg.
2. rupee = unit of currency in Nepal (1 US$ = Rs57, June 1997).

expenses on staking and irrigation (Rs), Pt = expenses on pesticides (Rs), Bd = bullock power (days), Fsr = farm size (ropani), Tp = transplanting dummy (assumes 1 when crop is transplanted and zero if produced in situ), Mn = micronutrient deficiency dummy, a_is are coefficients to be estimated in total labor employment, and e_L is a random disturbance term in total labor employment which is assumed to be normally and independently distributed. The area under the crop in argument normalizes the production function variables.

Employment of Female versus Male Labor

As presented earlier, vegetable seed is classified as a high-value crop and its production is a good income-generating program for rural women. In addition, it is often observed that farmers keep on producing vegetable seeds despite the fact that there is no economic profit derived from the program. One reason for doing this is to create more and regular employment to the family labor in the rural areas where there is a problem of underemployment. This aspect is examined as follows.

In rural areas where labor supply is abundant and rate of underemployment is high, agricultural laborers have to travel long distances in search of non-farm jobs. Besides their productive and reproductive roles, women in Nepal also have a very important social role–they take care of the disabled and elderly members of the family. This necessarily demands that women have to stay more at home than do the men folk. Aside from this, women are confronted with a lot of problems. They had smaller chances of getting an education at childhood. During pregnancy and lactation, moving afar becomes difficult for them. They need more social security than men. The total effect is that they have less opportunity than men in looking for and getting off-farm jobs. This causes a high supply of women labor in the family and hence in the locality. Therefore, for family farm work, irrespective of the price of female labor, the family first decides how much female labor will be employed. The family then decides how much male labor will be used. The men folk can go long distances in search of off-farm work, and their use in the family farm is affected by their opportunity cost in such off-farm works. This shows that the female labor that may be used for other household chores is affected more by the amount of male labor used rather than by their opportunity price in off-farm jobs. Therefore, in addition to variables in the total labor employment model, employment of female and male labor is determined simultaneously as follows.

Female labor employment model:

$$L_F = b_0 + b_1 L_M + b_2 Mq + b_3 Fv + b_4 Si + b_5 Pt + b_6 Bd + b_7 Fsr + b_8 Tp + b_9 Mn + e_F \quad (2)$$

Male labor employment model:

$$L_M = c_0 + c_1 L_F + c_2 Pml + c_3 Mq + c_4 Fv + c_5 Si + c_6 Pt + c_7 Bd + c_8 Fsr + c_9 Tp + c_{10} Mn + e_M \quad (3)$$

where L_F = employment of female labor, L_M = employment of male labor, Pml = price of male, and e_F and e_M = random disturbance terms in female and male labor models, and the rest are as explained in the total labor model.

The Data

This study was conducted in the Eastern Hills of Nepal. Eastern hills comprise the hilly districts of Koshi and Mechi zones of the Eastern Development Region. This program was started in Koshi zone about 15 years ago while in the Mechi zone, the program is still on trial. Of the 34.4 metric ton of vegetable seed produced in 1994, production in the Mechi Hills was only 0.9 metric ton (2.69 %). Hence, this study has focused only on the Koshi Hills (Samkhuwasabha, Bhojpur, Tehrathum and Dhankuta districts).

In 1996/97 (July to June), there were 71 farmers in Samkhuwasabha who produced vegetable seeds on contract. Similarly, there were 80 such farmers in Bhojpur, 95 in Tehrathum, and 168 in Dhankuta. Considering 30 farms in the sample from each stratum (district) (following Upton, 1973:215-217; Yang, 1965:5-11) to be adequate for a study of this type and thus taking a sample size of 30 respondents for Samkhuwasabha, proportional representative samples of 34 from Bhojpur, 40 from Tehrathum and 71 from Dhankuta were drawn comprising a sample of 175 respondents for this study. The survey was conducted from May to July 1997.

LABOR EMPLOYMENT AND ITS DETERMINANTS

Labor Employment

One of the arguments why farmers take up vegetable seed production even if there is low or negative net return is that the households want employment opportunities for family labor, which is highly underemployed. This aspect is examined here in terms of labor employment and its determinants.

In terms of labor employment, there were 19.73 labor-days employed per ropani in vegetable seed production as compared with 11.14 labor-days in competing crops (Table 1). This labor employment pattern in competing crop to vegetable seed crop showed a ratio of 1:1.77. The ratio for family labor was 1:1.63 and that for hired labor was 1:5.33. Employment of family labor (17.45 labor-days) per ropani in vegetable seed production was 73 percent higher than that (10.1 labor-days) in competing crops. It shows that farmers not only recover the opportunity cost of family labor used; they also achieve higher employment of family labor in vegetable seed production. Even though total hired labor was only 11.56 percent and 3.86 percent, respectively, in vegetable seed and competing crop production, there was higher rate of hired labor absorption in vegetable seed production. It may be thus being concluded that vegetable seed production not only helps reduce underemployment of the family labor but also helps reduce rural unemployment.

Table 1: Labor employment per ropani in vegetable seed and competing crop production in the Koshi Hills (1996/97)

Description of labour type		Vegetable seed production		Competing crop production	
		Number	Percent	Number	Percent
Family	Male	8.00	45.85	4.51	42.11
	Female	8.45	54.15	6.20	57.89
	Total	17.45	88.44	10.71	96.14
Hired	Male	0.94	41.23	0.16	37.21
	Female	1.34	58.77	0.27	62.79
	Total	2.28	11.56	0.43	3.86
Total	Male	8.94	45.31	4.67	41.92
	Female	10.80	54.69	6.47	58.08
	Total	19.73	100	11.14	100

On the ground that rural women, on top of their household chores, are already contributing 10.8 hours a day in farming (as compared with 7.5 hours by men) (Dahal, 1995; Acharya and Bennett, 1982), new development programs should not require these rural women to work more hours. In this study, it was found that the proportional increase in employment through vegetable seed production was greater in male (proportional increase by 4%) than in female (proportional decrease by 4%). This implies that market-oriented production programs such as vegetable seed production, which retain more male labor at the family farm, would help alleviate the drudgery of the rural farmwomen in Nepal in the long run.

Determinants of Employment

To evaluate the determinants of employment in vegetable seed production, the employment models given by equations 1-3 were estimated. The total labor employment model was estimated by OLS technique. The male and female employment simultaneous model was estimated by 2SLS technique. In the Breusch-Pagan chi-square test for heteroscedasticity, the data prepared to run the labor employment models were found to be heteroscedastic both in vegetable seed production and competing crop production. Hence, the results corrected for heteroscedasticity obtained from the Limdep-6 computer package were used for the interpretation of results. The results discussed in the text as significant refer to a significance level of 0.10 or more.

Table 2: Regression coefficients, standard errors, and employment elasticities for total labor employed per ropani in vegetable seed production in the Koshi Hills (1996/97) (Ordinary Least Squares Estimates)

Variable	Estimated coefficients	Employment elasticities
Constant	12.7380 ***	-
	(3.2480)	-
Price of labor (aggregate)	- 0.1063 **	- 0.1577
	(0.0413)	-
Manure	0.1944 ***	0.1283
	(0.0730)	-
Fertilizer	0.0057 ns	0.0177
	(0.0065)	-
Staking and irrigation	0.0100 ***	0.0973
	(0.0034)	-
Bullock	2.6300 **	0.1762
	(1.1270)	-
Expected return	0.0014 ns	0.1306
	(0.0012)	-
Farm size	- 0.0276 ns	- 0.0288
	(0.0312)	-
Micronutrient deficiency dummy	- 1.4597 *	
	(0.8603)	-
Transplanting dummy	1.7503 *	
	(0.9382)	-
Adjusted R^2	0.3484	
F value	10.328 ***	-

Note: ***, **, and * refer to significance at the 0.01, 0.05, and 0.10 levels, respectively
ns refers to not significant.
Figures in parentheses indicate standard errors.

Regarding the determinants of total labor employed per ropani, variables like manure, staking and irrigation, and bullock were positively significant (Table 2). The price of labor was negatively significant. A significantly lower level of employment was also found when micronutrient deficiency appeared on the standing crop. The growth of such crops was heavily restrained, thus requiring less of the pre- and postharvest activities. However, there was a significantly higher level of employment when farmer opted to produce seed through transplanting technique. Because the use of labor permits a farm operator to engage in other activities, bullock power appeared as a complementary input to human labor. Such positive and significant results were also found in earlier studies (Sidhu and Grewal, 1988; Staub, 1973).

The results of the simultaneous model show that male and female labor employment were not substitutes of each other but were rather complementary (Table 3). It implies that employment of both types of labor was simultaneously increased in the production program. In the labor-surplus subsistence type of farming, the marginal value product of labor did not determine the use of labor. Labor employment in family enterprises in such a case was characterized by work and income sharing (Ghatak and Ingersent, 1984:8). Because they share in the work, the

other thus complemented any opportunity in production that increases the use of male/female labor. This ultimately shows that male and female labor are positively related in determining the employment of each other in vegetable seed as well as in competing crop production.

Table 3: Regression coefficients, standard errors, and employment elasticities for female and male labor employed per ropani in vegetable seed production in the Koshi Hills (1996/97)
(Two Stage Least Squares Estimates of the Simultaneous Model)

Variable included in the equation	Female labour model		Male labour model	
	Regression coefficient	Employment elasticity	Regression coefficient	Employment elasticity
Constant	3.7031 *	-	1.4966 ns	-
	(2.0760)	-	(2.906)	-
Price of male labor	-	-	- 0.0361 *	- 0.1290
	-	-	(0.0199)	-
Female labor	-	-	0.3856 ns	0.4680
	-	-	(0.3298)	-
Male labor	1.0790 *	0.8893	-	-
	(0.5852)	-	-	-
Manure	0.1061 **	0.1277	- 0.0187 ns	- 0.0273
	(0.0540)	-	(0.0587)	-
Fertilizer	- 0.0031 ns	- 0.0178	0.0035 ns	0.0238
	(0.0061)	-	(0.0023)	-
Staking and irrigation	- 0.0024 ns	- 0.0419	0.0044 ***	0.0946
	(0.0044)	-	(0.0017)	-
Bullock	- 0.6940 ns	- 0.0848	1.1583 **	0.1718
	(1.2050)	-	(0.5383)	-
Expected return	- 0.0006 ns	- 0.1097	0.0008 ns	0.1714
	(0.0010)	-	(0.0005)	-
Farm size	- 0.0667 ***	- 0.1268	0.0364 *	0.0840
	(0.0243)	-	(0.0217)	-
Micronutrient deficiency dummy	0.7583 ns	-	- 0.9039 **	-
	(0.7244)	-	(0.3225)	-
Transplanting dummy	- 0.2635 ns	-	0.6158 ns	-
	(1.0260)	-	(0.4886)	-
Adjusted R^2	0.3530	-	0.5658	-
F value	10.519 ***	-	21.457 ***	-

Note: ***, **, and * refer to significance at the 0.01, 0.05, and 0.10 level, respectively.
ns refers to not significant.
Figures in parentheses indicate standard errors.

The price of male labor was negatively significant in determining the employment of male labor in vegetable seed production. A one percent increase in the price of male labor (opportunity cost of male labor working away from the family farm) was found to decrease employment of male labor in the farm by 0.129 percent.

Manure was positive and significant in determining female labor employment, while it had a negative sign in the male labor employment model (though not significant). Actually, hauling of manure was a very time-consuming and difficult work because of the terrain in the rural hills in Nepal. Manure was prepared beside the cattle sheds and the farms were spread over many small terraces. Hauling of manure was more of women's work in Nepal. Thus the use of more manure was positively significant in the female labor model. On the other hand, application of fertilizer was considered a skilled job and was mostly done by men. Fertilizer, though at 15 percent, was significant in the male labor model and had a negative sign in the female labor model. Because fertilizer is used as substitute to manure in the remote areas with difficult terrain for hauling manure from the animal-sheds to the production farms. This was somehow related here–when the use of manure was increased, the use of fertilizer was decreased and so was the work of male labor. When fertilizer use was increased, manure use was decreased and thus the work of women was reduced. This might have contributed to the negative sign of the coefficient of manure in the male labor model and that of fertilizer in the female labor model.

Staking and irrigation were found positively significant in determining the employment of male labor. Men mostly did irrigation by gravity channel. Thus, any increase in irrigation will increase the use of male labor. Staking using bamboo splits was done for crops like peas and beans during their growth and, in some cases to radish seeds at the time of podding when there is high bearing. Mostly, men did cutting bamboo and splitting them into pieces. Well-irrigated and staked vegetable seed crops have good growth and canopy (VDD, 1995). Because of this, fewer intercultural operations like weeding and hoeing (which were done mostly by women in Nepal [WFDD, 1993]) were required. Therefore, the coefficient of staking and irrigation was negative in the female labor employment model.

The results presented, so far, identified the significant variables in determining the employment of female and male labor in vegetable seed and competing crop production. The estimated employment elasticities with respect to a particular variable were not equal in the female and male labor employment models. Therefore, a statistical test is needed to confirm if the observed difference is significant. A confidence interval can be constructed and used to test such differences in employment elasticities (Staub, 1973:70-80; Youmans and Schuh, 1968:943-961; Heady and Dillon, 1961:580-584). If the difference between employment elasticities estimated for female and male labor employment with respect to a particular variable is significant, one may conclude that any policy affecting the use of that particular input will accordingly affect the employment of female/male labor. Such test results are presented in Table 4.

The results showed that the difference in employment elasticities estimated for female and male labor employment in vegetable seed production was significant with respect to manure, staking and irrigation, bullock, expected return, and farm size. These significant results also supported the earlier conclusion that any change in farm decisions that increases the use of manure will increase the use of female labor significantly. Similarly, the increase in farm size will bring about a significantly lower employment of female labor but significantly higher employment of male labor per ropani in vegetable seed production.

Table 4 Test of significance difference in the employment elasticities between male and female labor employment in the simultaneous model employed for vegetable seed production in the Koshi Hills (1996/97)

Variable	Computed b_i in female labour model[1]	Confidence interval[2]	Standard error in female labour model	Computed t-Statistics[3]
Manure	- 0.0227	0.1288	0.0540	2.3845 ***
Fertilizer	0.0042	0.0073	0.0061	1.2027 ns
Staking and irrigation	0.0053	0.0077	0.0044	1.7414 **
Bullock	1.4057	2.0997	1.2050	1.7425 **
Expected return	0.0010	0.0016	0.0010	1.6380 *
Farm size	0.0442	0.1108	0.0243	4.5544 ***

Note: ***, **, and * refer to significance at the 0.01, 0.05, and 0.10 level, respectively.
ns refers to not significant.

1 Computed b_i in female labor model to equal employment elasticity in male labor model = employment elasticity (e_i) in male labor model * (mean of female labor employed) /mean of X_i.

2 Confidence interval (CI) = computed b_i in female labor equation - true b_i in female labor model.

3 Computed t-statistics = confidence interval /standard error in female labor model.

CONCLUSION

Farmers are influenced by greater employment opportunity. This realization can lead to greater profit sharing and greater confidence in the contract negotiations. Because labor alone shares 41 percent of total cost of production, and farmers want to maximize the employment opportunity of family labor, it seems not possible to reduce per unit cost of seed by reducing the level of labor input until surplus labor in the family is absorbed by off-farm jobs.

Labor employment in the production of competing crops showed a complementary relationship between female and male labor. This implies that the study area is mainly characterized by subsistence farming. The labor employment ratio between competing crop and vegetable seed production was 1:1.63 and 1:5.33 for family and hired labor, respectively. This reflects the role of vegetable seed production in helping to alleviate under- and unemployment problems in the rural area.

REFERENCES

Acharya, M. and Lynn Bennett. 1982. Women and subsistence sector. Economic participation and household decision making in Nepal. World bank staff working paper No. 526. Washington D. C., USA: The World Bank

APP. 1995. Nepal agriculture perspective plan. Kathmandu, Nepal: APROSC and John Mellor Associates, Inc.

APPROSC.1983. Strategy for labor intensive agricultural development in Nepal. Kathmandu, Nepal: Agricultural Projects Services Center.

Dahal, M. K. 1995. Acknowledgment - in proceedings of the one-day seminar on gender sensitization issues in agriculture development in Nepal held on June12, 1995. Agricultural Projects Services Center. Ramshah Path, Kathmandu, Nepal.

Essang, S. M. and D. H. E. Oben. 1975. Labor absorption in large scale agriculture: a case study of Cameron Development Corporation Plantations. Malayan Economic Development Review, no 20.

Ghatak, S. and K. Ingersent. 1984. Agriculture and economic development. Bridgeton, Sussex, UK: Harvester Press.

Shah, A. J. 1980. The determinants of demand for labor in agriculture. New York USA: The Agricultural Development Council

Shrestha, R. P. and D. P. Adhikari. 1995. A position paper on policy constraints/ facilitation for private sector involvement on seed sub-sector of Nepal. Kathmandu, Nepal: Agro-Enterprise Center.

Sidhu, R. S. and S. S. Grewal. 1990. Factors affecting demand for human labor in Punjab agriculture: An econometric analysis. The Indian Journal of Agriculture Economics. 45(2): 125-134.

Staub, W. 1973. Agriculture development and farm employment in India. Foreign economic report no 84. New York, USDA: Economic Research Service.

Thapa, P. K. 1998. Economic efficiency of contractual vegetable seed production in the Eastern Hills of Nepal. Ph.D. Dissertation. University of the Philippines, Los Baños, College, Laguna, Philippines.

Upton, Martin. 1973. Farm management in Africa. Oxford: Oxford University Press.

VDD. 1995. Proceedings of the seminar/workshop on vegetable sector development in Nepal held during 21-23 June, 1995. Khumaltar, Lalitpur, Nepal: Vegetable Development Division.

Werner, R. A. 1995. Vegetable seed Series on vegetable seed supply to selected urban centers in Nepal. Volume 15. Khumaltar, Lalitpur, Nepal: Vegetable Development Division.

WFDD. 1993. Women farmers in Nepalese horticulture. A case study of selected districts and crops. Kathmandu, Nepal: Ministry of Agriculture, Women Farmer Development Division.

Yang, W. Y. 1965. Methods of farm management investigations for improving farm productivity. Revised ed. Rome, Italy: FAO

Youmans, R. and G. E. Schuh. (1968). An empirical study of the agricultural labor market in a developing country, Brazil. American Journal of Agricultural Economics. 50(4-5):943-961.