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**Non- Farm Rural Activities in Peasant Economy: Options for
Poverty Reduction, the Case of Peru**

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Abstract

Based on the successful experience of some Southeast Asian countries, the promotion of non-farm rural activities (NFRA) is currently proposed as a strategy for rural poverty reduction. At the present time in Latin America the non-farm rural sector, which includes handicraft production and other activities that depend on commerce, infrastructure and services, is highly important because of its effect on employment and productivity within rural economies. Those activities generate about 40 percent of farm household incomes. Later investigations have confirmed not only the significant role of these sources of income but their importance in supporting food security to rural communities. Recent studies carried out in rural Peru have found that 56 percent net income of rural households comes from these activities.

The paper explores the relevance of promoting NFRA as an alternative to improve the income and employment of poor peasant households. A household model framework, following contributions from Singh, Squire and Straus (1986) and De Janvry and Sadoulet (1996), was developed to explore the determinants of farm and non-farm income at the household level. Data set collected by the author from poor peasant villages - North Highland region - was used as empirical evidence.

The paper illustrates the case of a traditional rural industry, a handicraft activity, with strong demand linkages to a farm economy. In such a context, it has been identified that the expansion of the activity faces demand and supply side constraints. This outcome contrasts with the general optimism expressed by current literature on the rural non-farm economy that suggests that this may be an important source of jobs and incomes for rural development and poverty alleviation. However, based on the empirical findings some caution should be taken on this issue. Firstly, the type and nature of linkages between the rural non-farm activity and the rest of the economy should be identified properly. Secondly, the nature of the good offered by the rural industry has to be assessed adequately. The extent to which the supply side can adjust to the demand side requirements is an important element that can be used to assess the relevance and feasibility of any rural non-farm activity for employment creation and income generation.

The analysis of household non-farm income composition showed a mixed picture explained, to some extent, by the nature of the goods being supplied (normal or inferior). Two cases of NFRA were identified: 1) Activities with potential to overcome constraints at household and market levels, in the presence of significant external intervention. 2) NFRA that are marginal in the household composition and without options of expansion.

To conclude, due to the complexity of the peasant economy and in order to identify the relevance of the NFRA, it is proposed to carry out the following levels of

analysis: 1) at the household level analysis could be argued that the non-farm household incomes depend on the access to physical assets (land, capital goods), financial, organizational assets, human assets (education, migratory experience), as well as access to specific goods and public services. 2) The market level analysis which allows exploring the limitations and constrains hindering the expansion of traditional non-farm rural activities by analyzing the market demand and supply of goods and services provided by NFRA. It is also suggested to study the NFRA linkages with other markets, and specially, how the macroeconomic context affects the expansion possibilities of such activity. 3) The macro level of analysis should focus on policy interventions within the framework of poverty reduction programs.

Key words: Non-farm rural activities, peasant economy, poverty reduction, Peru

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1.- Introduction

In Latin America, the non-farm rural sector is particularly important because of its effect on employment and productivity of rural economies. The income generated by this sector is a growing part of rural income, even for the poor, and plays an important role in guaranteeing food security in rural communities. Recent survey evidence contradicts the traditional image that farming income is synonymous with rural income (Reardon, et al. 1998). Non-farm rural incomes are significant as an off-season, part time or home-based income source for rural households. From a Latin American perspective, according to a number of case studies, it is estimated that non-farm income and employment account for 40 per cent and 25 per cent of the rural totals, respectively (Reardon, et al., 1998). In Peru, the share of non-farm rural income is even higher at 44.3 per cent (Escobal, 2001a).

This paper focuses on two primary issues. Firstly, it investigates the role played by access to assets in determining rural incomes in the context of a peasant economy in the North Peruvian Sierra. Secondly, it offers a deeper understanding of the expansion options of a traditional home-based and labour intensive rural industry, namely straw hat making in the district of Bambamarca. It is estimated, using the poverty line criterion, that 64 percent of the rural population is poor in 2007 (Yancari, 2009). So, it is in the context of poor peasant families that there is the challenge of promoting non-farm rural activities as a means of improving family income and of offering employment opportunities.

The issues examined in this paper are attracting the attention of academics and international institutions (e.g. World Bank, IFPRI and ODI). Much empirical work is focused on non-farm rural sector and poverty reduction issues in Asia, Africa, Latin America and transition economies. Studies of rural income determinants using mainly national surveys can obscure wide variations in stages of economic development at the regional or local levels. So, a case study offers the advantage of knowing in depth the potential for and constraints on non-farm income expansion in the context of a backward rural region.

The paper is divided into 5 sections. The next section focuses on the theoretical literature which emphasizes the effect of access to assets, such as natural, human, physical, financial, social, location and infrastructure, in determining rural incomes. It also provides quantitative information on the importance of non-farm incomes in rural Peru and discusses the empirical results on the determinants of non-farm and farm income at the household levels. Section 3 deals with the market analysis at the empirical level, both demand and supply analyses were undertaken. The former was based on a demand system and associated income elasticities and quality elasticities were estimated. The supply approach investigated the analysis of hat price differences and calculation of labour return.

Based on the empirical analysis carried out, a typology of non-farm rural activities in the context of a peasant economy is suggested in section 4. Concluding remarks are presented in section 5.

2.- Determinants of rural household incomes: an asset based approach

The non-farm rural sector has been an important area of research in the economic development literature. Two main areas of analysis can be identified: i) the study of inter-linkages between agriculture and the non-farm sector as a whole or within a region of a country; and ii) the analysis of the role played by the non-farm sector in the process of rural development. An important line of research has been the analysis of income diversification strategies carried out by rural households (Islam, 1997). This approach will be explored in this section.

Why do rural households decide to take part in non-farm rural activities? According to Ho (1986), the level of participation in rural non-farm activities is determined by a combination of push factors and pull factors. The former factors emphasize the limited capacity of agriculture to absorb labour, given the constraint of limited arable land. Therefore, in a scenario of increasing population density and a reduction of the size of landholdings, families see themselves in need of finding alternatives to complement their agrarian income. On the other hand, the pull factors are related to the availability of attractive and more profitable opportunities of work in the non-farm sector. The author also notes that the relative importance of these factors depends partly on the stage of economic development and the intensity of the population pressure on land use. For the particular case of this study's research area, in which families are located in a poor region with low level of economic development, it is pertinent to assume that the push factors have a decisive influence in defining the participation of these families in rural non-farm activities. That is to say, non-farm rural activities are fundamentally activities of "refuge" that allow the family to have access to a source of an immediate and relatively secure income – being less risky than agriculture – although they participate in activities of low productivity¹.

In order to analysis the determinants of rural non-farm incomes, the framework for livelihood analysis proposed by Ellis (2000) offers an explanation based on the assets approach. The author (2000, p.31) notes '...the assets owned, controlled, claimed, or in some other means, accessed by the households ... are the basic building blocks upon which households are able to undertake production, engage in labour markets, and participate in regional exchanges with other households'. Asset ownership by the rural poor is increasingly recognized as being essential to sustained and broad-based economic growth. Assets are related to activities as part of the income-generating strategies of the households. As Barrett and Reardon (2000) put it:

'Assets are stocks of directly or indirectly productive factors that produce a stream of cash or in-kind returns.(...) Portfolio theory, on which much of the diversification literature depends, emphasizes assets as the subject of agent choice when trying to maximize expected income, minimize income variability, or some combination of the two. So assets are a logical subject of the study of diversification behavior. Indeed, asset and income distributions

¹ Lanjoux (2001) and Isgut (2004) also noted, in the context of El Salvador and Honduras respectively, that self-employment jobs may offer only a 'last resort' income source.

are analytically inextricable from one another' (Barrett and Reardon, 2000: 10).

The materialization of a set of assets into a stream of income-earning activities is mediated by two sorts of factors. The first one is the social factors, which are endogenous to the social norms and structures such as social relations, institutions and organizations. The second consists of exogenous factors such as economic trends, policies, and shocks, which have important implications for livelihood security and environmental sustainability. More specifically, the decision to engage in non-rural income earning activities will depend on i) the incentives – such as yield and risks – when carrying out farming activities and ii) the capacity of the households to undertake the rural non-farm activity, which in turn is determined by access to assets, including its level of education, income and credit (Reardon et al., 1998).

The literature reports the analysis of a number of aspects of the relationship between assets and income generation. For example, there is an important body of research that links the process of asset accumulation with the household's ability to manage and to cope with risky environments. Along these lines, Alderman and Paxson (1992) summarize and discuss the literature on risk and consumption in the rural sectors of developing countries. The available empirical evidence analysed by the authors suggest that the effect of risk on production and investment decisions depends on how well households can cope with income risk. Poorer households appear to forgo potential incomes in order to mitigate risk; this strategy in turn affects production decisions such as the level of investment and technological innovation. Rosenzweig and Binswanger (1993), using data from rural India, explain how the composition of productive and non-productive asset holdings varies across farmers with different levels of total wealth and across farmers facing different degrees of weather risk.

In an analysis of poverty in Latin America, Attanasio and Székely (1999) proposed a simple framework for the study of the relationship between assets and poverty and also discussed the restrictions that the poor face for accumulating income-earning assets. The empirical analysis, based mainly in household national surveys, covered countries such as Brazil, Bolivia, Chile, Colombia, Costa Rica and Peru. The authors were aware of the model's limitations and emphasize the necessity of developing and estimating models that recognize the incentives and opportunities each individual household faces. 'Those models would allow the identification of the main determinants of the process of accumulation of different productive assets (specially human capital), and would give policy makers an invaluable instrument to evaluate different policy proposals' (Attanasio and Székely, 1999: 37). For the Peruvian case, the authors confirm that assets play a crucial role in the probability of exiting poverty. A much better distribution of assets is associated with higher social mobility and better prospects for wider sectors of the population.

A broad classification of assets, based on Siegel and Alwang (1999), is presented in Table 1. The following types of assets are identified: natural, human, physical, financial, social, location and infrastructure, and political and institutional².

² Assets can be classified in a variety of ways. In spite of the fact that most of the recent econometric studies on determinants of rural incomes deal explicitly with household access to assets, only the paper of Winters et al. (2002) categorised assets as natural, physical, human, financial, public and social capital. Social assets or social capital is the most controversial in terms of definition (Attanasio and Székely, 1999). Following Putnam et al.'s (1993) definition, "social capital refers to features of

Table 1 Assets Classification

Asset Type	Household and public assets
Natural	“Private” land, pasture, forests, fisheries, water.
Physical	Productive assets (tools, equipment, work animals) Household assets (housing, household goods and utensils) Stocks (livestock, food)
Human	Household composition and size Health and nutritional status Education and skills
Financial	Cash, saving, access to credit, and insurance markets
Social	Household social ties and networks Intra-household dynamics
Location and Infrastructure	Proximity and access to water and sanitation, education and health, marketplace, information systems, storage facilities, roads
Political and Institutional	Participation in household decision making (including power relations related to gender and age)

Adapted from Siegel and Alwang (1999: 11, Table 3.1).

It is assumed that assets are employed in two activities: farm and non-farm activities. Furthermore, assets are classified according to ownership or access, that is, assets may be held privately by individuals³ or collectively, as public goods, without restriction on access. Government expenditure is assumed to have a greater role as the provider of the latter assets. A particular case is the extreme situation where no government expenditure has been allocated to create public assets in poor rural areas. In that context, the creation of public assets is expected to have a “pull effect” in enhancing economic activities in both farm and non-farm categories in terms of self-employment and wage employment. Furthermore, improvement in or access to water, sanitation, education, health and roads are expected to increase the quality of human assets, which therefore increase household labour productivity. It is important to note that human assets create a multiplier effect on labour productivity. In particular, location and infrastructure assets are included in this respect.

Taking public assets into consideration is consistent with the growing number of empirical studies in rural Latin American and other regions that conclude that access to public services are key determinants of rural non-farm incomes (Ellis 2000, Reardon et al., 2001, Isgut, 2004). Furthermore, evidence is currently available for

social organization, such as trust, norms and networks that can improve the efficiency of society by facilitating coordinated actions”.

³ Community level assets can also be part of household private assets. For a further development see Siegel and Alwang (1999).

supporting the hypothesis that government investment has an important role in promoting non-farm activities.

The model used here follows from Singh et al. (1986, chapter 2). In the context of farm household models, it has been a common assumption to consider farmers' decision on consumption and production as separable, therefore the theoretical problem can be analyzed as an independent profit-maximizing producer and utility-maximizing consumer. Assuming a separable model, households are price takers in the final and input markets. Hence, the difference in income composition would be explained mainly by the differences in household assets⁴.

In a typical rural household, members must undertake optimal decisions on production and consumption. The model captures the situation of a household engaged in farm activity, crop and livestock production, non-farm micro enterprise producing crafts and labour migration. The production process is assumed to be risk-free. The factors used in farm production are land, labour and purchased inputs. In the case of handicraft output, the factors required are labour and inputs. Farm output is either consumed on-farm or sold in markets. Handicrafts are sold only in markets. The household has endowments of time, farm and non-farm assets.

The consumption bundle consists of the food staple, market purchased goods and leisure. The household is a price taker in all markets and faces no transaction costs in these markets. It is constrained by its resource endowments, a full income constraint, existing production technologies, and the exogenous market price. The household maximises a profit function with respect to production constraints. The solution to this maximisation problem gives the labour allocation among the different productive activities. The corresponding production levels are subsequently defined. As result, monetary income is generated and decisions on consumption are taken based on the maximization of a utility function. What is interesting at this level of analysis is the study of the income composition between farm and non-farm sources, which can be considered as an outcome of this theoretical exercise. Thus, once the different monetary income sources are known it will be possible to identify its determinants and assess the impact of access to assets.

2.1 Rural Incomes in Peru

Table 2 presents the net income per capita in rural Peru. The primary source for these data is the 1997 Encuesta Nacional de Niveles de Vida (ENNV, Living Standard Measurement Surveys) covering a nationally representative sample of Peruvian rural households. The information is organized by region⁵ and according to

⁴ Asset-based approaches are multidisciplinary in nature, with contributions from economics, sociology, anthropology and environmental sciences. "The new literature on asset-based approaches has its genesis in Amartya Sen's entitlement approach. This approach was incorporated into the sociological/anthropological literature by the late 1980s and entitlements were expanded to include social capital and other forms of tangible assets. Asset-based approaches have begun to be reintroduced into the mainstream of economics literature, which is increasingly recognizing the importance of social capital to human and social development". (Alwang et al., 2001: 9). From an anthropological perspective, Guyer (1997) suggests that economics and anthropology appear to be heading toward a new convergence of concern around the nature and use of assets.

⁵ Peru is divided into three distinct topographic and climatic regions: The Coast, a narrow coastal area, is the centre of the country's industrial, commercial and agricultural activity. Lima, the political and economic capital, is located here. The Sierra, or the Highlands consists of the Andes Mountain, high plateaus and valleys that cover 27 per cent of the land area. The upper Amazon basin is the most

main income sources. In rural Peru, 44 per cent of the net income of rural households is derived from non-farm activities, suggesting that these are no longer supplementary to agricultural production. However, important regional differences exist. Non-farm income accounted for 53 per cent in rural Sierra households, the poorest region in the country. By contrast, for a household located in the Coast region, the richest area, non-farm income is about 21 per cent of total income while, in the Amazon region its share is 37 per cent. This seems to suggest that the level of poverty is associated with a higher participation in non-farm activities. Hence, push factors may explain this greater participation in the Sierra region (Escobal, 2001a).

Table 2 Net Income by Source in Rural Peru, 1997 (in current US\$ per capita)

	Coast	Sierra	Amazon	Rural Peru
Farm activities				
Self-employment	455.5 (67.6%)	130.3 (41.6%)	169.7 (56.5%)	167 (49%)
Wage employment	76.6 (11.4%)	16.7 (5.3%)	20.6 (6.9%)	22.7 (6.7%)
Non-Farm activities				
Self-employment	97.8 (14.5%)	109.2 (34.8%)	79 (26.3%)	101.1 (29.7%)
Wage employment	44.3 (6.5%)	57.2 (18.3%)	31 (10.3%)	49.9 (14.6%)
Total	674.2 (100%)	313.3 (100%)	300.3 (100%)	340.6 (100%)

Sources: Estimation based on 1997 LSMS surveys. Escobal, J. (2001) "Determinants of Nonfarm Income Diversification in Rural Peru" in *World Development*. Vol. 29. No. 3. Table 4, p. 502.

2.2 The Survey

A household survey was conducted in four villages of Bambamarca, a district located in the high altitude Sierra of northern Peru in the Cajamarca Department. Bambamarca town stands at 2,532 meters above sea level, and is located at 120 km. from the city of Cajamarca, the capital of the Department. The provincial capital, Cajamarca City, serves as a commercial centre for the rural activities of the surrounding countryside. The main economic activities of the province include agriculture and livestock production, followed by commerce, mining and tourism. For the Bambamarca district, the rural population is 78 per cent of the total population, which is high when compared with the national ratio of 30 per cent. The rate of poverty in the Cajamarca Department, based on the poverty line criterion, is among the highest in Peru at 77 per cent of total population in 2001, compared with 47 per cent at the national level. Physical infrastructure is rudimentary and many

extensive but least populated region of Peru. The rain forest covers an area equivalent to 60 per cent of the national territory.

residents lack basic services, such as water delivery services, electric lighting and sewerage (INEI, 2001).

Four villages of Bambamarca district were selected randomly. The following criteria were used:

- a) Two villages with marginal non-farm rural activities were chosen, i.e., crop and livestock production should be significant in terms of family income and employment.
- b) Two villages with important non-farm rural activities, in particular hat production, were selected.

For each of the two groups, one village was located near Bambamarca town or the main road, and the second one far from Bambamarca. This was done in order to capture the relevance of distance to the market and city in household participation in non-farm activities.

Pusoc and Tallamac were chosen as the farm villages, Marco Laguna and El Frutillo as the non-farm villages. A random sample of 208 households was chosen to reflect the distribution of the population in rural Bambamarca. The household level information was complemented by a village questionnaire, which gathered information on access to public services, main economic activities, transportation costs and local prices.

Rural non-farm activities are related to employment, income and livelihoods that are not directly derived from agriculture (crops, livestock husbandry, woodlot production, hunting, fishing and forestry). It includes local non-farm rural employment⁶ as well as urban jobs. Individuals who reside in an area defined as “rural” carry out those activities (Reardon et al. 2001). In the case of Peru, “rural” in the context of household national surveys is based on 2,000 maximum persons per locality (Ministerio de Trabajo y Promoción Social, 1999).

All income was measured in terms of annual household income and net household income was estimated, including home-consumed crops⁷ and incomes in cash. Farm income comprised self-employment farm income (including net income from all crop production and returns from traded livestock) and wage farm income. Non-farm income, the focus of attention in this paper, was defined as: profit from non-farm activities derived from food processing, textiles and garments, wood and straw hat and petty commerce, plus wage earnings from non-farm labour. The remaining item in household total income was remittances from long-term non-residents. Table 3 shows the income composition in the sample villages. As can be seen from this table, most of the income is generated within the household. On average for all the villages, farm income corresponds at 49 per cent; non-farm activity represents 50 per cent and remittances account for only 1 per cent. However, when the analysis is made considering each village, important differences emerge. Hence, as expected, El Frutillo and Marco Laguna villages have the highest share in non-farm income, with an average of 91 per cent, while Tallamac and Pusoc show lower participation with 7.5 per cent. The most notable fact is that wage income is not very significant among all the villages.

It is important to note that the absolute value of income from non-farm villages is lower when compared with farm villages’ income. In addition, the sample

⁶ The terms non-farm and off-farm employment are frequently used synonymously, but, in fact have different definitions. For further discussion see Start (2001), Ellis (2000) and Barrett et al. (2001).

⁷ Crops not sold were valued at the means of local town prices.

average household income is higher than the non-farm villages' incomes. This fact seems to suggest that the poorest households would be engaged in non-farm activities in rural Bambamarca, being self-employment income the major income source.

Table 3 Annual Net Family Income by Village in Bambamarca, 1999-2000.

	Farm Villages		Villages with NFRA		Total Sample
	Tallamac	Púsoc	El Frutillo	Marco Laguna	
Total Income in New Soles	3,922	4,546	3,489	3,426	3,728
1. Total Farm Income	3,487	4,228	626	472	1,812
2. Total Non-farm Income	347	290	2,861	2,937	1,882
Self-employment	164	245	2,730	2,920	1,786
Wages	183	45	131	17	96
3. Remittances	88	38	2	17	34
Share in Total Income					
4. Total Farm Income	89	93	18	14	49
5. Total Non-farm Income	9	6	81.9	85.5	50
Self-employment	4	5	78	85	48
Wages	5	1	3.9	0.5	2
6. Remittances	2	1	0.1	0.5	1

Source : Survey conducted by author in Bambamarca, Peru, 2000.

*At the time of the survey, the exchange rate was £ 1.00 = 5.6 New Soles, Peruvian currency.

2.3 Modelling Households Responses

This section empirically investigates the determinants of non-farm and farm incomes. A data set compiled from a sample survey undertaken in 2000 in four towns in rural Bambamarca, Peru is employed. The findings are then compared to those of some major studies on the issue and conclusions are drawn about the importance of assets in explaining farm and non-farm incomes in the context of a peasant economy.

2.3.1 Determinants of non-farm incomes

Since 31 percent of the households in the sample did not report non-farm income during crop year 1999/2000, a model correcting for sample selection bias was used. However, all households reported at least some level of farm incomes, so

that an ordinary least squares (OLS) model was used for the estimation of farm incomes.

Turning to the empirical model, it is assumed that there is an underlying regression relationship explaining the level of rural non-farm income:

$$\text{LnNFinc}_i = X_i\beta + \varepsilon_{1i} \quad (1)$$

where the dependent variable, non-farm rural income, is expressed in log terms and X_i denotes the set of explanatory variables. However, the dependent variable is not observed for households that do not report non-farm income. Rather, the dependent variable is observed if

$$Z_i\gamma + \varepsilon_{2i} > 0 \quad (2)$$

where

$$\varepsilon_1 \sim N(0, \sigma)$$

$$\varepsilon_2 \sim N(0, 1)$$

and ε_1 and ε_2 have correlation ρ .

Z_i denotes the set of variables thought to determine whether the household gains non-farm income.

For $\rho \neq 0$, standard regression techniques applied to the non-farm income equation produce biased estimates of the β parameters. Maximum likelihood estimation of the regression model with selection yields consistent, asymptotically efficient estimates for all the parameters⁸.

The dependent variable, annual non-farm income, was expressed in log terms. The set of independent variables posited to explain the level of non-farm income comprises: i) natural assets, namely arable land owned in hectares (Landsize); ii) physical assets, represented by the stock of cattle in ovine equivalents⁹ (Cattle) and a dummy variable denoting household access to irrigation, use of fertilizer and control pest management (Ferpestirri); iii) human assets, represented by the number of working household members (Labour), age (Headage) and education of head of household (Headedu) and years of experience in hat making activity (Craftexpe); iv) social commitments in the form of participation in communal work (Commuwork); v) infrastructure, denoted by a dummy variable capturing the household access to a paved road (Pavedroad) to Bambamarca town, the main trade centre in the region.

It is hypothesized that household access to human and location assets has a positive impact on non-farm incomes. However, the presences of natural and physical assets, which are closely related to farm activity, are expected to have a negative influence on non-farm incomes. Social commitments in the form of communal work are also expected to reduce the time available for non-farm work.

⁸ In fact ML estimation does not estimate σ and ρ directly, but rather $\ln \sigma$ and $\text{atanh } \rho$, where the latter is: $\text{atanh } \rho = \frac{1}{2} \ln \left(\frac{1+\rho}{1-\rho} \right)$. Stata 7 was used for all estimation. Note that Heckman (1979) suggested a

two-step estimation procedure: probit estimates of the selection equation are obtained and then the computed non-selection hazard (the inverse of the Mills ratio) is used to augment the regression equation.

⁹ The stock of cattle has been standardised to ovine equivalents (*borregas*). This criterion is related to the forage requirement for each type of cattle (Maletta, 1990).

The detailed definitions of all variables with their sample means and standard deviations are presented in Table 4.

The classification of assets follows Siegel and Alwang (1999) presented above. Data were available on natural, physical, human, and social assets, as well as location and infrastructure.

Table 4 Household Participation in Non-Farm Rural Activities, Bambamarca: Descriptive Statistics

Variables		Full Sample		Households with non-farm income		Households without non-farm income	
		Means	Std. Deviation	Means	Std. Deviation	Means	Std. Deviation
Dependent Variables							
Lnonfarminc	Ln of rural non farm income	4.99	3.50	7.25	1.15	0.00	
Lfarminc	Ln of farm income	6.73	1.61	6.14	1.55	8.03	0.75
Independent Variables							
Asset Type							
Natural							
Landsize	Arable land owned in ha.	1.82	2.24	1.57	1.93	2.39	2.75
Physical							
Cattle	Ovine equivalence of stock cattle	12.23	13.91	9.48	12.03	18.28	15.83
Ferpestirri	Dummy variable. 1 if hh access to irrigation, use of fertilizer and control pest	0.16	0.37	0.29	0.46	0.11	0.31
Human							
Farmtime	Hours per year in man equivalent allocated to farm activities	1,243	1,100	999	1,045	1,779	1,033
Labour	Number of working household members	3.18	1.64	3.43	1.76	2.63	1.18
Sizefam	Number of family members	5.24	2.16	5.78	2.24	4.06	1.42
Child6	Number of children aged 0-6 years	0.68	0.91	0.80	0.99	0.40	0.61
Child7-14	Number of children aged 7-14 years	1.23	1.26	1.44	1.34	0.77	0.90
Headage	Age of household head in years	44.80	13.84	44.45	12.69	45.52	16.17

Table 4...continued

Variables	Variable Definitions	Full Sample		Households with non-farm incomes		Households without non-farm incomes	
		Means	Std. Deviation	Means	Std. Deviation	Means	Std. Deviation
Age*Age	Age of household head, squared	2,196	1,343	2,136	1,206	2,330	1,608
Headsex	Dummy variable: 1 if head of hh is male	0.96	0.20	0.94	0.23	0.98	0.12
Headedu	Years of education of household head	4.21	3.03	4.37	3.04	3.85	3.02
Famedu	Average years of formal education of household members > 15 years old	3.11	1.45	3.21	1.42	2.90	1.59
Migrant	Dummy variable: 1 if household member migrated temporarily outside Bambamarca	0.10	0.30	0.05	0.22	0.20	0.40
Craftexpe	Household head's experience in hat making (years)	12.12	14.63	17.63	14.64	0.0	0.00
Social Comwork	Dummy variable. 1 if household takes part in communal work (<i>ronda campesina</i>)	0.73	0.45	0.71	0.45	0.75	0.43
Location and Infrastructure Farcity	Distance from village to Bambamarca town (km)	14.75	7.97	13.80	8.97	16.85	4.52
Pavedroad	Dummy variable. 1 if household is in a location with access to a paved road to Bambamarca town	0.25	0.43	0.36	0.48	0.0	0.00
Other Market	Share of total value of potato and maize production which is sold	0.11	0.21	0.08	0.18	0.18	0.24
Sample size		208		143		65	

Source: Survey conducted by author in Bambamarca, Peru, 2000.

In order to identify the main features of the households engaged in non-farm activity, a probit model was estimated. The independent variables were two types of assets, human assets and location assets. i) The former was expressed as family composition (number of children aged 0-6 years old, Child6, number of children aged 7-14 years, Child7-14, and number of working family members, Labour), migrant experience of household member (Migrant which is a dummy variable), characteristics of the household head (years of schooling, Headedu, age, Headage, and age squared, Age*age), and the formal schooling of household (average years of formal schooling of the household members older than 15 years old, Famedu). ii) Location asset is represented by the distance in kilometres from the village to Bambamarca town, which is the main trade centre in the region (Farcity). Additionally, the level of farming market integration was included as the share of total value of potato and maize production which is sold (Market).

It is hypothesised that the age composition of the family will have a positive effect on participation due to the fact that non-farm activity involves self-employment which facilitates carrying out their household tasks. Furthermore, a high number of dependants increase the need for getting additional monetary income in order to meet consumption needs. Similarly, the presence of working members is expected to positively influence the probability of household participation in non-farm activities because of the labour intensive nature of the hat making activity – the most important non-farm activity in the research zone – and the relatively low or zero entry restrictions into the activity.

The presence of a migrant household member could have an ambiguous effect on household participation in non-farm activities due to the varied job opportunities available to each household in the local and regional labour markets. If the local economy is mainly concentrated on primary activities, then, farm and extracting activities offer most of the off-farm labour opportunities. On the other hand, if a more dynamic and highly diversified economy is the main nexus with the village economies, then, it increases the options of engaging in non-farm activities.

Education enters in two forms: i) the years of schooling of the head of household and ii) the average household years of formal education for household members older than 15 years. The effect of both variables on the participation equation is expected to be positive. Education, as an indicator of human capital, is expected to lead to higher wage and better job opportunities in the non-farm sector.

The age variables (Headage and Age*Age) denote the stage of the household in its life cycle as well as its experience. These variables are expected to have a positive influence on household participation in non-farm activities. However, the effect of age might be non-linear, hence, the age squared variable is included and its effect is expected to be negative, reflecting diminishing marginal effect on household participation in farm activities. Thus, at older ages, the probability of participation would decrease as age increases.

Infrastructure is expected to have a positive influence on household participation in non-farm activity since it increases household access to market opportunities and reduces its transaction costs in market participation. The condition of roads was used as a proxy for the infrastructure asset variable.

Finally, a variable indicating the degree of farm market integration (Market) was included. It is expected to have a negative impact on household participation in non-farm activity. However, bearing in mind the diversification behaviour of peasant families, this outcome is not conclusive.

Table 5 presents the results of the non-farm income regression estimation. The result from the probit model evaluates the probability of participation in non-farm activities while the income equation identifies the variables determining the level of non-farm incomes. A detailed discussion of each equation proceeds.

The likelihood-ratio test for independence reported in Table 5.2 is equivalent to the test for the null hypothesis and is the comparison of the joint likelihood of an independent probit model for the selection equation and a regression model on the observed non-farm income data against the Heckman model likelihood. The $Z = -0.47$ and χ^2 of 0.22, both denoting that the $H_0: \rho = 0$ is not rejected. Hence, ρ is not statistically significant, indicating that the sample selection issue is of relatively minor concern in this case. This result suggests that there are no unobserved variables that influence the probability of participation in the non-farm activities.

Table 5 Determinants of Non-Farm Rural Income in Rural Bambamarca, 1999-2000. Maximum Likelihood Estimation, Heckman Procedure

Dependent Variable: Lnonfarminc	Estimate	Z*	P> z *
Non-farm Income Equation			
Natural asset			
Landsize	0.0384	0.80	0.422
Physical asset			
Cattle	-0.0131	-1.56	0.118
Ferpestirri	-0.1962	-0.61	0.539
Human asset			
Labour	0.1585	3.28	0.001
Headage	-0.0210	-2.30	0.022
Headedu	0.0040	0.11	0.914
Craftexpe	0.0325	5.17	0.000
Infrastructure asset			
Pavedroad	0.3247	1.65	0.099
Constant	7.0760	16.65	0.000
Participation Equation			
Human Asset			
Child6	0.6265	4.04	0.000
Child7-14	0.2591	2.57	0.010
Labour	0.2472	3.15	0.002
Migrant	-0.6615	-1.79	0.074
Headedu	0.0738	1.32	0.185
Famedu	0.0516	0.57	0.566
Headage	0.0292	0.48	0.634
Age*age	-0.0002	-0.31	0.758
Location asset			
Farcity	-0.0324	-2.53	0.011
Other			
Market	-0.7801	-1.65	0.100
Constant	-1.5844	-1.02	0.306
Goodness of fit			
Athrho	-0.1748	-0.47	0.636
Rho:	-0.1731		
Sigma :	0.9000		
Lambda :	-0.1558		
Log Likelihood	-285.4714		
$\chi^2_{(7)}$: 44.74			
Prob > χ^2 : 0.000			
Wald test of independence equation (Rho=0)			
$\chi^2_{(1)}$: 0.22			
Prob > χ^2 : 0.6363			
Number of observations: 208			
Uncensored Obs. : 143			
Censored Obs.: 65			

The Z statistic is the ratio of the coefficient to the standard error. P>|z| is the significance of the coefficient.

2.3.2.1 Participation Equation

The age of household head and age squared variables have the expected signs but are not significant. Both education of the household head and average household years of formal education have the expected effect but were also not significant in explaining household participation in non-farm activity. Both results may indicate the limited variation of the variables across the total sample. The presence of children aged 0-6 years and 7-14 years had a positive and significant effect on participation in non-farm activities. The nature of home-based activity and self-employment, mainly hat making, can explain this outcome.

With respect to family size and composition, the empirical literature offers mixed results on their influence on the probability of participation in non-farm activities. Household size has a positive influence on the probability of participation in rural non-farm activities for the rural El Salvador (Lanjouw, 2001). Meanwhile household size was not found to be relevant in the case of rural Brazilian households (Ferreira and Lanjouw, 2001). For a sample from rural Ecuador at the individual level, it was found that the effect of household size was negative and not significant, but when estimation took account of the probability that a rural household will undertake a home enterprise, household size was positive and highly significant (Ferreira and Lanjouw, 2001). Participation in both non-farm wage employment and self-employment was found to be positively related to family composition in rural Honduras. A positive and highly significant relationship was also found with the number of adults and incomes while a negative and significant relationship was identified with respect to the ratio number of children to number of adults (Ruben and Van den Berg, 2001). Adding a working household member was estimated to increase the probability of household participation in non-farm activities. A study from rural Ghana found similar results, in relation to the male participation in non-farm employment (Abdulai and Delgado, 1999).

It is important to note that the surveyed villages are in the same district where the capital is Bambamarca town. The distance from Bambamarca town to the most distant village is 23 kilometres and the distance to the nearest one is 3 kilometres. The fact that Farcity variable is negative and statistically significant implies that households far from Bambamarca town decrease their probability of participation in rural non-farm activities and are more likely to be engaged in farm activities. The nature of potato production, the main cash crop in the region, is such that it requires landholding located in high altitudes and these lands are far from the main town¹⁰. In this case, geographical conditions and production requirements for the main cash crop appear to be the underlying factors explaining the relationship between participation in non-farm activity and distance to the market.

Regarding farm market participation it was found that households which report a higher share of sold crop out of total production are significantly less likely to take part in non-farm activities. This finding implies that when a household is more integrated to the farm market as a food supplier, then the probability of participation in non-farm activities decreases. A similar effect was found for rural Ecuador (Elbers and Lanjouw, 2001) and rural El Salvador (Lanjouw, 2001) for the case of individuals from households with some income from cultivation.

¹⁰ Cajamarca is located in the higher Andes. The selected villages are situated in three main ecological zones: valley, slope (lower hills), and jalca (upper hills). Potato production takes places in the slope and jalca zones, with altitude varying from 3,200 to 3,700 meters (Bernet, 1999). Bambamarca town has an altitude of 2,532 meters.

In summary, the results of the participation equation suggest that human assets, such as family composition by age and number of working household members, have a positive and significant influence on participation. However, education variables, age and age squared of the household head, while exhibiting the expected sign are not significant. A household with a migrant member has lower a probability of participating in non-farm activities. A negative and significant relationship was found between distance to the market in kilometres and participation. Finally, a household with a high share of sold crop has a lower probability of participating in non-farm activities.

2.3.2.2 Income Function

Land size has a positive effect on non-farm income but was not significant. This result suggests that households diversify their activities, a feature of peasant economies that seems to be confirmed in the case of Bambamarca villages. This finding, specific to a peasant family sample, departs from the findings of a national survey of rural households in Peru described by Escobal (2001a). The author reported that land size in hectares has a negative impact on self-employment non-agricultural income although the coefficient was not significant. However, empirical work on other countries is consistent with the Bambamarca findings. For instance, for Ecuadorian rural individuals participating in non-agricultural wage employment, it was found that land ownership per capita has a positive but not significant effect on incomes (Elbers and Lanjouw, 2001). A similar result, not significant, was also reported for rural households in Mexico (De Janvry and Sadoulet, 2001), rural El Salvador (Lanjouw, 2001), rural Ghana (Abdulai and Delgado, 1999), rural India (Rosenzweig, 1980), rural Sri Lanka (Sahn and Alderman, 1988), peri-urban households in Tanzania (Lanjouw et al., 2001) and rural Nicaragua (Corral and Reardon, 2001) when determinants of self-employment rural incomes were analysed. Furthermore, for rural households in Southern Mali the relationship between landholding and non-farm incomes was positive and significant (Abdulai and CroleReiss, 2001). A similar effect is reported by Winters et al. (2002) for the case of the Mexican *ejido* sector, where both irrigated and rainfed land are significant variables in explaining non-agricultural self-employment income.

The effect of the cattle stock was negative and significant at the 10 percent level. An extra unit of cattle results in a decline in non-farm incomes of 1.31 percent, *ceteris paribus*¹¹. Apparently, there is a trade off between participation in livestock activity and non-farm activity, but there is a complementary relationship between food production and non-farm activity. In Cajamarca City, the capital of the Department, there are two main dairy product factories that produce the full range of dairy products from processed cheese to flavoured milk for local and national market. Peasants from villages surrounding the Department are the main suppliers of fresh milk production on a daily basis. At the national level, Escobal (2001a) also found a highly significant negative effect of livestock (measured in sheep equivalents, which was also tested in the Bambamarca case) on self-employment non-agricultural income.

As expected, households with access to irrigation water, use of fertilizer and control pest management, that is, the potato producers, had a lower non-farm income. However, the variable is not significant, suggesting that diversification into non-farm activities takes place.

Education of household head in years of schooling has a positive but not

¹¹ It is important to bear in mind that the coefficients in a multiple regression model can only be interpreted under a *ceteris paribus* condition, which says that the other variables that are included in the model are constant (Verbeek, 2000).

significant effect on non-farm income. In addition, average household years of education for members older than 15 years was considered in the empirical analysis. However, this variable was also not significant. It can be suggested that this outcome is due to the relatively low levels of educational attainment of the survey respondents. For instance, when looking at the head of household group, 70 percent has some level of primary schooling, while most wives have not attended school. This suggests that the sample are mainly households composed of low-skilled workers. This means that when decisions on labour market participation are taken, members are mainly engaged in low-labour productivity activities, either in self-employment or in wage employment. Therefore, their participation in the labour market is restricted to farming, construction, transport, street trading, and domestic service.

Empirical work using national level data shows that education is a positive and highly significant variable in explaining self-employment non-agricultural income for a sample of Peruvian rural households (Escobal, 2001a). International empirical evidence, of which a vast majority was based on national household surveys, also shows a positive relationship between education and non-farm income. In rural Nicaragua, it was found that average years of education of adult household members was a positive and highly significant determinant of both non-farm wage income and non-farm self-employment (Corral and Reardon, 2001). This result is in line with findings for rural El Salvador (Lanjouw, 2001) and rural Ecuador (Elbers and Lanjouw, 2001), where, in the latter case, a strong direct association between education and non-agricultural wage labour incomes was estimated. Furthermore, in rural Pakistan, years of education of adult male members are significant determinants of non-farm net earned income; however, with adult female members the relationship identified was negative and not significant (Fafchamps and Quisumbing, 1999). For the case of rural Ghana, a significant positive impact of education in determining the non-farm wage equations of husbands and wives was also reported (Abdulai and Delgado, 1999). A similar result was described for rural Uganda (Canagarajah et al., 2001). For the peri-urban households in Tanzania, estimates indicate a dramatic impact of schooling, both primary and secondary education, to non-farm incomes (Lanjouw et al., 2001). Furthermore, Winters et al. (2002) found in a national sample of the Mexican *ejido* sector that the education level of male household members is a positive and highly significant determinant of non-agricultural wage employment.

In making these comparisons it is noted that when a Peruvian national household survey is used for the estimation of rural non-farm incomes, education shows an unambiguous positive effect on incomes. However, in the present study of Bambamarca, this relationship may be weaker because we are dealing with a sample of peasant households mainly engaged in self-employment activities (both farm and non-farm), and located in a traditional backward region with a high level of rural poverty.

Age of household head is negative and highly significant in explaining non-farm income. The estimated coefficient suggests that one additional year of age of the household head reduces the non-farm income by 2 percent. However, empirical studies elsewhere report a significantly positive relationship between age of the household head and non-farm income, for instance, in rural Pakistan (Adams and He, 1995), rural Uganda (Canagarajah et al., 2001), peri-urban households in Tanzania (Lanjouw et al., 2001), rural households in Southern Mali (Abdulai and CroleRees, 2001) and El Salvador (Lanjouw, 2001).

Regarding the number of household working members, a positive and significant relationship was found. One additional working household member is

estimated to increase income by 16 percent, suggesting that non-farm activities are labour intensive. To some extent this is explained by participation in hat manufacture, which is a self-employment activity. A similar result is reported for the case of the number of both adult males and adult females in rural households in Southern Mali (Abdulai et al., 2001).

An additional year of experience in hat making is translated into an increase in non-farm income of 3.25 percent. Skills and capabilities are mainly transmitted from fathers to their children so that accumulated family knowledge is the main method of transferring skills to the new and potential hat makers.

The effect of access to a paved road on non-farm income was positive and significant at the 10 percent level¹². The estimated coefficient suggests that when a household is in a location with a paved road, it would have a non-farm income, *ceteris paribus*, 33 percent higher than a household with no access to a paved road¹³. This confirms results for Latin American countries as such rural Nicaragua (Corral and Reardon, 2001), and rural Chile (Berdegue et al., 2001).

At the national level, Escobal (2001a and 2001b) shows the role of some key public assets such as rural electrification and roads in defining non-farm income in rural Peru. Moreover, in assessing the benefits of roads in rural Peru, the author's findings emphasise the importance of an improved rural road system in reducing transaction costs and thus improving the incomes of rural households. His main results indicate that transaction costs equal 50 percent of the sales value, being appreciably higher for producers who are connected to the market via non-motorized tracks, and the transaction costs are much higher for small-scale farmers than for large-scale ones, 67 percent versus 32 percent of the sales value, respectively.

This outcome is in line with the analysis of public assets in promoting rural non-farm incomes from a Latin American perspective (Reardon et al. 2001). For instance, from a nationally representative sample of Mexican *ejido*, Winters et al. (2002) found that access to basic infrastructure, such as water, sewage, bathrooms and telephones, mean higher incomes for self-employment and non-agricultural wage employment, and is similarly a positive influence on farm income from crop and livestock production.

A general assessment of the variables defining non-farm income shows that human asset variables, such as experience in hat making and working household members, and infrastructure, such as access to a paved road, are positive determinants of non-farm incomes in rural Bambamarca. Furthermore, assets related to farm activity, such as physical assets represented by cattle stock, and use of fertilizer, irrigation water and pest control management, have negative effects on non-farm income, as expected. However, access to natural capital such as land has a positive, but not a significant, effect on non-farm incomes. This result may be due to a household diversification strategy between farm and non-farm activities where access to land is consistent with participation in other activities in order to complement or increase household incomes.

For the Latin American region, Reardon et al. (2001) found that the key determinants of rural non-farm incomes are education and access to infrastructure such as roads, electricity, drinking water, and proximity to the city. In particular, a strong

¹² It is important to note that the paved road variable is also a dummy for El Frutillo village and the significance of this variable could be picking up the unobserved fixed effects due to the villages and not just the paved road condition.

¹³ For dummy variables, the effect is estimated by using $[\exp(\beta) - 1]$, where β is the regression coefficient of the dummy variable (Halvorsen and Palmquist, 1980).

relationship was found between education and participation in more productive and better-remunerated employment.

A different picture is found in the case study of Bambamarca, where non-farm self-employment activity, which is 90 percent concentrated on hat manufacture, constitutes the highest share in total income. This finding shows that insufficient human assets, reflected in household member's years of schooling, and limited access to public infrastructure would be the main entry barriers for successful household participation in highly productive and better remunerated jobs.

2.3.3 Determinants of Farm Income

The full sample consists of 208 observations and all households report some amount of farm income during 1999/2000 crop year. Therefore, an OLS model was used for the estimation of the farm income function.

The dependent variable of the farm income, *Infarminc*, was expressed in log-transformed terms. The first independent variable to be considered was natural assets in the form of arable land in hectares (*Landsize*). Physical assets were also included, which was expressed as the ovine equivalence of stock of cattle (*Cattle*) and as a dummy variable for household access to irrigation water, use of fertilizer and pest control management (*Ferpestirri*). The *Ferpestirri* variable captures the main feature of the input requirements for potato production. It represents the joint use of water, fertiliser and pest control management and is expected to have a positive impact on potato yields (Velazco and Caballero, 1996). In addition, indicators of human assets were included. One was age composition of the family represented by number of children aged 0-6 years (*Child6*) and number of children aged 7-14 years (*Child7-14*). A second indicator was the estimated number of hours per year in man equivalent allocated to farming activity, which represents farm labour force (*Farmtime*). A third indicator represented education measured by the number of years of schooling of the household head (*Headedu*) and the average number of years of formal education for household members aged 15 years and over (*Famedu*). A fourth indicator reflected the characteristics of the household head, which were age (*Headage*) and sex (*Headsex*). Finally, labour migration experience of household member was represented by a dummy variable (*Migrant*).

Social assets¹⁴ were represented by a dummy variable that has the value of 1 if the household takes part in communal work and 0 otherwise. Lastly, location assets are represented as the distance in kilometres from the village to Bambamarca town (*Farcity*).

It is hypothesised that natural assets, physical assets, social assets and human assets as education variables and time devoted to farm activities will have positive influence on farm incomes. However, the impact of family composition by age, sex of household head, migrant experience and location assets, on farm income would be ambiguous.

For household *i* the farm income model is expressed as:

¹⁴ A further discussion about the measures of social and public capital in the context of rural income function determination is found in Winters et al. (2002).

$$\begin{aligned}
Lnfarminc_i = & \alpha_0 + \alpha_1 Landsize_i + \alpha_2 Cattle_i + \alpha_3 Ferpestirri_i + \alpha_4 Child6_i + \alpha_5 Child7-14_i \\
& + \alpha_6 Farmtime_i + \alpha_7 Famedu_i + \alpha_8 Headedu_i + \alpha_9 Headsex_i + \alpha_{10} Headage_i + \alpha_{11} Migrant_i \\
& + \alpha_{12} Comwork_i + \alpha_{13} Farcity_i + \varepsilon_i
\end{aligned}
\tag{3}$$

The least-squares regression results are presented in Table 6.

Table 6 Determinants of Farm Income in Rural Bambamarca, 1999-2000. OLS Estimation¹

Dependent Variable: Lnfarminc	Estimate	t*	P> t *
Natural asset			
Landsize	0.1773	3.11	0.002
Physical asset			
Cattle	0.0332	6.33	0.000
Ferpestirri	0.6722	3.27	0.001
Human asset			
Child6	-0.1702	-1.83	0.069
Child7-14	-0.1009	-1.59	0.114
Farmtime	0.0005	7.33	0.000
Famedu	-0.0467	-0.77	0.441
Headedu	0.0389	1.22	0.223
Headsex	0.2409	0.53	0.598
Headage	-0.0060	-0.77	0.442
Migrant	0.6615	3.39	0.001
Social asset			
Comwork	0.2341	1.35	0.180
Location asset			
Farcity	0.0194	1.88	0.061
Constant	5.1568	7.56	0.000
Goodness of fit			
R ²	: 0.58		
F(10, 197)	: 24.51		
Prob > F	: 0.000		
Number of obs.	: 208		

*The t statistic is the ratio of the coefficient to the standard error. P>|t| is the significance of the coefficient

1/ Robust standard errors were computed.

These results indicate a reasonably good overall fit ($R^2 = 0.58$). A joint test on the hypothesis that all independent variables have a zero coefficient is rejected by the F-test, which is highly significant. To account for heterocedasticity, White's robust covariance matrix was used in calculating the standard errors (Greene, 2000).

Landholding size is positive and highly significant in explaining farm incomes¹⁵. An additional hectare owned is associated with higher farm income by about 17.7 percent¹⁶. At the national level, Escobal (2001a) estimated a positive and significant relationship between land size in hectares and self-employment agricultural income¹⁷.

The stock of cattle is another variable that is significantly associated with income. One additional unit of cattle increases farm income by 3.32 percent. A similar effect was found at the national level between livestock and self-employment unskilled agricultural income (Escobal, 2001a).

Based on the parameter estimates in Table 6, a household with access to irrigation, use of fertiliser and control pest management would expect to earn about 96 percent more, *ceteris paribus*, than a household with no access. This outcome supports the conclusion that an adequate management of potato production guarantees higher farm incomes.

Family composition by age also affects farm incomes. The presence of children younger than 6 years and between 7 and 14 years reduces farm incomes. One additional child below 6 years will decrease farm incomes by 17 percent.

A household with a member who migrated temporarily outside the Bambamarca district would have a farm income 94 percent higher than a household with no migrant. This finding confirms the fact that migrants work as farm wage labour in the provinces of the Coast and Amazon regions where the average daily wage is threefold the local wage in Bambamarca town. Migrant household members are mainly heads of households and elder sons. This result shows the importance of participation in the rural labour markets as a household income-generating strategy.

A positive and highly significant relationship between farm income and household time allocated to farming was found. One additional male equivalent day per year, assuming a working day of 8 hours, will increase farm income by 0.04 percent. A similar direct relationship was also found in Uganda (Appleton, 2001).

Gender and age of the head of household were not significant variables in explaining farm incomes.

Various authors have investigated the importance of education in farm activity, such as income, production and technical innovation¹⁸. However, in the

¹⁵ Caution should be taken when assessing the relevance of arable land owned and cattle stock in explaining farm incomes due to the endogeneity of those variables. That is, households may have relatively large landholding or stock of cattle because they have high farm income, rather than the opposite. Clearly, the decision on land and cattle stock demand implies an inter-temporal framework, which is not properly captured by the cross section characteristics of the data set. In order to test endogeneity, the Hausman test is proposed, which requires a set of instrumental variables that are correlated with either arable land owned or stock of cattle, but not correlated with farm income. However, such variables were not available from the data set.

¹⁶ The estimated coefficient of land could be downward biased if the omitted land quality variable is negatively correlated with land size but positively correlated with income. López and Valdés (2000) report a similar problem for the case of Latin America and Jayne et al. (2001) for the case of Africa.

¹⁷ Escobal et al. (1999) studied the interaction effect of access to assets in a national sample of Peruvian households. The authors found that the productivity of assets may be significantly enhanced if more than one type of asset is owned. Specifically, owning physical capital in the form of land has much higher returns when the asset is combined with human capital.

¹⁸ The literature on determinants of agricultural innovation emphasize socio-economic factors such as farm size, risk, human capital, availability of labour, credit and form of land tenure (Feder, Just and Zilberman, 1982; Feder, 1982; Feder and Slade, 1984). In the Southern Sierra of Peru, Figueroa (1986) and Cotlear (1989) identify education as a key factor behind the adoption of new technologies.

context of traditional agriculture, those effects are not directly realised, therefore the linkage between education and farm incomes is not strong enough.

Household participation in communal work, *rondas campesinas*¹⁹, was positive and statistically significant at 18 percent in explaining farm incomes. This result implies that when producers are organised, on a rotation basis, for taking care of cattle and the security conditions of the village, a better environment for carrying out farming activity is generated therefore increasing incomes.

A household located an extra kilometre farther from Bambamarca town would expect a higher farm income by 2.3 percent. Potato production requires landholdings located in a valley and slope terrain, which are far from the town. This finding is consistent with the estimates of the participation equation for the non-farm income in Table 5 when it was identified that distance to the town in kilometres (Farcity) was negatively associated with the probability of participation in non-farm activities.

In general, the estimation of farm incomes has demonstrated the importance of assets, such as natural, physical, human, social and location, as positive determinants of farm incomes in rural Bambamarca. However, the human assets showed a mixed result. Family composition by age had a negative effect on incomes indicating that the presence of dependents reduces the level of labour allocation to farm activities, thus, reducing the options for higher incomes. Education of household head was a positive but not significant variable and average household education was negative and not significant in explaining farm incomes. These findings seem to suggest the limited or null impact of schooling in a peasant economy characterised by a high incidence of poverty. Furthermore, age and sex of household head were not significant variables. Finally, the migrant variable exhibited a highly positive and significant effect on farm incomes. This result confirms the findings of non-farm incomes about the important role played by rural markets in offering job opportunities to the peasant households.

3. Expansion constraint to a traditional rural industry: A marker analysis

The rural non-farm activity to be analysed is the traditional industry of straw hat making in Bambamarca, North Peruvian Sierra. Historical references corroborate the long lasting tradition in hat making in the research area. The weaving of straw hats is not a recent activity for the families of Bambamarca. It is considered a traditional rural industry with a long history. During the colonial period, the first weavers of hats, those of good quality, had already crossed the Peruvian Coast in search of new markets and some of these hats were sent abroad (De Wit, 1991). The earliest historical reference about hat making activity in Bambamarca is from 18th century (Contreras, 1995). The 1876 National Census provides additional information, recording that in Bambamarca, around 90 persons were engaged full

¹⁹ In order to have a more precise idea about the importance of the *rondas campesinas* in the village organization, the description provided by Gitlitz (2001) is pertinent: "During the late 1970s, beset by cattle rusting and theft in general, and in the face of a state judicial system which was at best distant and incompetent, and at worst thoroughly corrupt, the peasants of the small, disbursed, minifundista communities of the northern Peruvian Andean department of Cajamarca organized a system of local patrols, or rondas, and began to administer justice on their own. By the middle of the 1980s they had created what in essence was a parallel and informal legal system addressing virtually every kind of local dispute, both civil and criminal - not only the dramatic cases such as rustling - but also the much more common and mundane problems of everyday life: family problems, feuds between neighbors, petty theft, etc." (Gitlitz, 2001:2).

time in hat manufacture, while most of the peasants took part in it as a complement to farm activity (Censo General de la República del Perú, 1876, Tomo III: 708-63; quoted by Taylor, 1994:43). Furthermore, based on other official documents, it is known that, during the 19th century, hats made in Bambamarca were sold in the Coast region.²⁰

Historical information seems to suggest that hats were classified according to quality and the input used which had a direct impact on their prices. For instance, the Official Journal “El Peruano” dated 18th November 1874, gave an account of Bambamarca hats being produced using white straw from Mollebamba, a town located in the Amazon region, and junco straw from the Coast. Around 70 hat makers were identified and hat prices were ranked between 2 to 10 *soles* (local currency) according to type and quality (quoted by Campos, 1992:90)²¹. This description shows the key feature of this rural industry with respect to the external supply of straw, the main input in the activity. This input came from other Peruvian regions. Currently, this feature remains; however, the main input is now imported from Ecuador.

The historical account provides information about the long tradition in hat making activity in the research area and, most importantly, the identification of the linkages in the rural industry between consumers located in the Coast region, presumably most of them from rural town and villages, and input suppliers coming from the Coast and Amazon regions.

Hat making is a labour-intensive activity. The manufacture of a hat, depending on its quality, may last from two to four weeks. All the family members take part in the braiding process throughout the day and night. The sale of hats is a key mechanism for the monetization of farmers, who have limited or no surplus from farm production. This means the higher the family’s self-consumption of its total agricultural and livestock production, the greater will be need to create additional income sources by manufacturing and selling hats. Hence, hat-making activity is performed almost the whole year, requiring excessive work hours from family members (Velazco and Caballero, 1996).

This section focuses on the empirical analysis of hat demand and hat supply. Two main issues are explored: the discussion of quality differences in hat demand and the analysis of labour return in hat making activity²².

3.1 The hat demand analysis: Demand and Quality Effect

This section is concerned with the estimation of a quality elasticity using cross-sectional household survey data on quantity purchased and price paid. Several household expenditure surveys collect data on quantity purchased as well as expenditure. This allows unit values to be calculated by dividing expenditure by quantities.

Prais and Houthakker (1955) discussed the idea of the responsiveness of quality to change in income. The authors calculated the “quality elasticity” from

²⁰Personal communication between the Bambamarca Governor and the main political authority, *Sub-prefecto*, in Hualgayoc, dated in 1st January 1886. This information was provided to the author by Dr. Lewis Taylor.

²¹ The quotation in Spanish, from Diario Oficial el “Peruano” (18 November 1874), says: “Se tejen sombreros de paja blanca, de Mollebamba y de junco de la Costa. Hay setenta sombrereros; quienes venden de dos a diez soles según su clase y calidad”.

²² A detailed partial equilibrium model describing the hat making activity is found in Velazco, Young and Colman (2006).

regressions of the logarithm of the unit value on the logarithm of household income. In this section, quality elasticities are estimated following, in principle, the procedure proposed by Prais and Houthakker (1955), but instead of using unit values, the hat price paid is considered. Following this method it is expected that the effect of quality in hat demand can be properly captured. In this respect, it is important to note that “in the final analysis, the quality issue can only be solved by additional direct measurement of quality or by independent recording of market price” (Deaton, 1989:199).

In analysing family budgets, price variations can be explained by (i) quality differences, (ii) spatial variations, (iii) price discrimination, (iv) differences in the accompanying services purchased together with the commodity and (v) seasonality (Prais and Houthakker, 1955). In this section, it is assumed that the main source of price variations is quality differences.

Expenditure on the commodity i is denoted E_i , which is the product of quantity, X_i , and price, P_i , thus producing equation (4):

$$E_i = X_i * P_i \quad (4)$$

The change in expenditure on commodity i can be decomposed into a change in quantity and a change in price as shown in equation (5):

$$\log E_i = \log X_i + \log P_i \quad (5)$$

In a standard Engel analysis, expenditure and quantity demand on good i depend on total household expenditure (M) and family characteristics (A), as expressed in equations (6) and (7):

$$E_i = f_1(M, A) \quad (6)$$

$$X_i = f_2(M, A) \quad (7)$$

Assuming a change in total household expenditure (M), equation (5) becomes:

$$\frac{\partial \log E_i}{\partial \log M} = \frac{\partial \log X_i}{\partial \log M} + \frac{\partial \log P_i}{\partial \log M} \quad (8)$$

which can be re-written in terms of elasticities as:

$$\eta_{EM} = \eta_{XM} + \eta_{PM} \quad (9)$$

Equation (9) shows that total expenditure elasticity, η_{EM} , can be decomposed into the quantity elasticity and the quality elasticity, the second term of the right-hand side as proposed by Prais and Houthakker (1955). If no quality differences exists, the quality elasticity is zero, with $\eta_{PM} = 0$. If quality differences are important,

then quality elasticity is positive, with $\eta_{PM} > 0$, implying that when income falls a low quality good is demanded²³.

In general, two stages are carried out in the estimation of quality elasticity. At the first, the expenditure elasticity with respect to total expenditure is estimated based on equation (6). At the second stage, the quantity function is used to estimate the quantity elasticity with respect to total expenditure as indicated in equation (7). Once expenditure and quantity elasticities are estimated, quality elasticity is the difference between them as specified in equation (9).

Data compiled from a sample survey implemented in 2000 in two farm villages in Bambamarca, Peru, is employed. So, Pusoc and Tallamac villages serve as examples of representative rural hat consumers. Households were asked to report the quantity bought and the price paid for hats during the previous 12 months. One-year recall is considered to be adequate to capture hat purchases. No spatial price variations can be assumed since consumers make their hat purchases in the Sunday market in Bambamarca town and would thus face the same price. However, if the actual price data varies, it can be explained by two reasons: (i) quality differences and (ii) measurement errors²⁴. The advantage of the current data set, compared with standard national household surveys, is that prices and quantities were collected. So, this fact avoids the inconvenience of employing unit values instead of the actual prices. To some extent, this procedure guarantees that error measurement is minimised and any price variation could be explained mainly by consideration of quality issues.

33 percent of the households reported zero expenditure on hat. Therefore, the presence of zero observations of the dependent variable in the current sample precludes the use of standard econometric procedure such as the ordinary least squares (Greene, 2000). Zero purchase outcomes in household survey data are usually interpreted as the result of (i) short-run consumption behaviour or infrequency of purchase, (ii) consumers' sensitivity to commodity prices or income, i.e. a corner solution, and (iii) social, psychological or ethical distinctions.

The Tobit-type censored model interprets the household zero-purchase outcomes as the result of strictly economic decisions, i.e., goods are not purchased when they are too expensive, generating a corner solution. Double hurdle models are used for dealing with infrequency of purchase and abstention behaviour (Burton et al., 1996; Jensen and Yen, 1996; Dong and Gould, 1999; Angulo et al. 2001, and Newman, 2001)

For the estimation of Engel functions, a double-hurdle model of consumer purchase behaviour as originally proposed by Cragg (1971) and a Tobit model are used. The Cragg model anticipates that households must overcome two hurdles before realising a positive purchase. The first one involves market participation, i.e. becoming a potential purchaser, and the second hurdle comprises making the purchase (Greene, 2000).

For the particular case of hat demand, it is assumed that the infrequency of purchase model is not relevant because data on hat expenditure were collected based

²³ A theoretical and empirical analysis of this relationship is found in Theil (1952), Cramer (1973) and Cox and Wohlgenant (1986).

²⁴ When comparing hat prices on a monthly basis, seasonality in the price variation was observed. Based on information obtained from workshops with consumer households, it was found that most hat purchases were made during the rainy season, hence price seasonality would have limited impact on the estimates. (Fieldwork, October 2000).

on one-year recall. In addition, low-quality hats, which comprise a major portion of hat demand, have a durability lasting one year.

Both hat expenditure (Hatexp) and hat quantity (Hatquant) are the dependent variables. The explanatory variables include log on expenditure per capita (Lnexpcap), family composition expressed as number of children aged 0-14 years old (Child14), male members aged between 15-24 (Man15-24) and 25-64 years old (Man25-64). Similarly, female household members were divided into the number of female between 15-24 years old (Wom15-24) and 25-64 years old (Wom25-64), as well as the presence of elderly people (Elderly). A set of dummy variables was added for the educational attainment of the head of household (Highschool), in particular it is important to know if heads with any level of high school, more than 7 years of education, influence hat demand. A second binary variable is whether the household is near to Bambamarca town, the main trade center in the region (Nearcity).

It is hypothesised that household incomes, family composition by age and sex, and proximity to the city have positive impact on hat expenditure (quantity). However, household head with high school education is expected to have negative effect on hat expenditure.

The Cragg model was tested against a Tobit specification. Since the double-hurdle model nests the Tobit model a likelihood ratio test is performed between both models (Greene, 2000). Based on the critical Chi-square value with 9 degrees of freedom at the 1 percent and the 5 percent levels, it was found that Tobit model was preferred to the Cragg model. Hence, the results suggest that the observed zero expenditures are consistent with a traditional corner solution, that is, zero hat purchases are due to economic reasons. So, the basic specification of the empirical Tobit model used is the following:

$$y_i^* = x_{ai}'\beta + \varepsilon_i \quad \text{and} \quad (10)$$

$$\begin{aligned} y &= 0 & \text{if } y^* &\leq 0 \\ y &= y^* & \text{if } y^* &> 0 \end{aligned}$$

where:

$$y_i^* = \text{Hatexp, Hatquant}$$

Hatexp = Annual hat expenditure in Peruvian New Soles

Hatquant = Quantity of hat demand

$x_{ai}' = (\text{Lnexpcap, Child14, Man15-24, Man25-64, Wom15-24, Wom25-64, Elderly, Highschool, Nearcity})$

Findings indicate that a single-stage approach is appropriate in modelling the demand for hats, with the Tobit model providing a better representation of factors that influence hat demand. The estimated coefficients for the Tobit model are reported in Table 7.

Table 7 Tobit Model: Determinants of Hat Expenditure Function and Hat Quantity Function in Rural Bambamarca, 1999-2000

Dependent Variables	Hat Expenditure Function	Hat Quantity Function
Independent Variables		
Log of expenditure per capita	208.872 (6.18)***	1.176 (4.37)***
Number of children younger than 14 years old	48.166 (3.11)**	0.268 (2.15)**
Number of male aged 15-24 years	32.454 (1.38)	0.091 (0.47)
Number of male aged 25-64 years	47.516 (1.21)	0.188 (0.58)
Number of female aged 15-24 years	73.546 (3.06)***	0.697 (3.56)***
Number of female aged 25-64 years	98.129 (3.99)***	(0.681 (3.39)***
Number of adults over 65 years	52.707 (1.91)*	0.714 (1.65)
Household head with > 7 years education ⁺	-103.926 (-2.51)**	-0.785 (-2.30)**
Household near Bambamarca town ⁺	19.888 (0.65)	0.259 (1.04)
Constant	-1440.765 (-5.93)***	-8.111 (-4.20)***
Goodness of fit		
Log likelihood value	-469.776	-134.147
Wald χ^2 (9)	46.36	33.98
Prob. (L.R. Statistic) > χ^2 (9)	0.000	0.000
Left-censored observations	34	34
Uncensored observations	70	70

t-values in parentheses

Dummy variables are indicated by ⁺

*Significant at 10% level; ** at 5% level; *** at 1% level.

The variables that have a positive effect in determining the expenditure and the quantity functions are household expenditure and family composition by age and sex, in particular the presence of female household members. On the other hand, a negative impact is associated with the level of education of the household head. Results suggests that, ceteris paribus, a head household with any level of high school education (more than 7 years) spends on hats 4 Peruvian New Soles than a household head with no high school education.

The elasticity of expenditure, quantity and quality were computed from the Tobit estimates and results are shown in Table 8.

Table 8 Hat Quality: Estimation of Expenditure Elasticity, Quantity Elasticity and Quality Elasticity with Respect to Total Expenditure

Elasticity	Log of Per capita expenditure
Expenditure (η_{EM})	1.73*
Quantity (η_{XM})	1.19*
Quality (η_{PM})	0.54*

Source: Based on parameters from Table 2

Notes: * Significance at 1 percent level.

The significance of the elasticities is based on standard deviations of the Tobit model.

The expenditure elasticity of hats for all forms of household expenditure indicates that hats are luxury goods. As expected, both the quantity elasticity and quality elasticity are positive²⁵. Thus, the elasticity of expenditure on hats with respect to log of per capita expenditure is estimated to be 1.73, which decomposes into a quantity component of 1.19 and a quality component of 0.54. This result shows clearly that i) hats are luxury goods, and ii) quality up grading is an issue for hat demand²⁶. As expected, the quality elasticity is positive, implying that as income increases, the consumer buys a better quality of hat at a higher price.

Does the hat making activity in Bambamarca face a demand constraint? In dealing with this question, the following approach should be considered: i) Assuming that tastes and consumer preferences are fixed, changes in the level of hat demand arise from changes in the real income or changes in its relative prices. Empirical evidence about the trend in hat consumer's income reveals that for Tallamac village, when monetary annual family incomes in real terms are compared between 1993/1994 and 1999/2000 crop years, a average annual growth rate of -8% was estimated. Using data from Living Standard Measurement Studies Household Survey (ENNIV in Spanish) it was estimated that between 1994-2000, the average annual growth rate of household expenditure for rural Sierra and rural Coast households was -2.53% and -3.47%, respectively. This means that falls in consumer real income, ceteris paribus, would have affected negatively hat demand, and consumers would shift to buy low quality hats.

ii) Considering changes in the tastes and consumer behaviour of the rural population in the face of access to education and increasing urban experience could be bringing about a decline trend in hat demand. Information from National Census and Household National surveys shows an increasing access to primary and high school education in rural areas. One result of the Tobit model mentioned above was that

²⁵ Analysis of the data showed that the average price paid for hats rose as income rose. As income increases consumer buy better quality hat and the price paid increases. A correlation coefficient between hat price and household income of 0.6 was estimated with 1 percent level of significance.

²⁶The original procedure of quality elasticity estimation as suggested by Prais and Houthakker (1955) was also used. This method is based on a semi-logarithmic relation expressed as $P = \alpha + \beta \log M$, where P is the average hat price paid, and M is either total expenditure or expenditure per capita. Considering only those households that purchased positive quantities, the quality elasticities estimated were 0.47 and 0.27 for total expenditure and expenditure per-capita, respectively. Those results are in line with the findings discussed in Table 8.

access to high education of household head has a significantly negative impact on both hat expenditure and hat quantity functions. This fact provides reasons to believe that changes in peasant family preferences and tastes would be expressed in a declining interest in using straw hats.

Therefore, in order to answer if there is a demand constraint in the hat making activity, the information analysed seems to suggest that a declining trend in the rural demand for hat is the more likely outcome given falling farmer incomes and expected changes in consumer preferences. At this point of the argument, the link between hat making activity and the farm economy is identified as a key aspect in the demand side static analysis. This means that hat consumers are farmers from villages and small towns from Sierra and Coast regions. The growth in farm incomes provides an expanding market for hats produced by the traditional rural industry. So, a strong direct relationship could be outlined between farm incomes and non-farm incomes in this particular context. Therefore, a rapidly growing agriculture sector offers, given demand patterns, a stimulus for higher rural non-farm incomes. Clearly, the opposite picture emerges when agriculture is stagnant²⁷. In such circumstances, consumers opt for reducing their demand for hats or deciding to buy low quality hats. This latter decision, in particular, has important consequences on the labour return of the hat makers and, therefore, in their living conditions. This issue will be discussed in the next section.

3.2 The hat supply analysis: Analysis of labour return

Hat making is a labour intensive activity. Depending on its quality, it may take two to eight weeks to produce a hat. The sale of hats is a key mechanism for the money income of peasants who have limited or no surplus farm production. This means, the higher is the family self-consumption as a share of the total agricultural and livestock production, the greater their need to generate income sources by manufacturing and selling hats. For these households, this activity is performed almost the whole year, requiring excessive work hours from family members.

Table 9 shows a hat price decomposition analysis based on the input-output technology (See appendix for a description of the variables used).

²⁷ One indicator of stagnant agriculture in Tallamac is given for the comparison of potato yield. In 1995/1996 harvests the yields reached 5,208 kg/ha, whilst in 1999/2000 they were 3,597 kg/ha (Field work in Bambamarca 2000).

**Table 9 Components of Hat Price According to Quality
(Monetary values in Peruvian New Soles)**

Quality	Hat Maker No.	Hat Price P_h^p	Hat* Margin λ_2 (%)	Input price P_i	Input* Margin λ_1 (%)	Total hours per hat, a	Labour return per hour, w
Total sample	259	105.5 (62)		22.3 (5.8)		151.9 (40)	0.52 (0.24)
Low Quality All sample	221	87.15 (27.9)	55	21.2 (5.4)	40	144.9 (36.8)	0.46 (0.15)
High Quality All sample	38	214.6 (92)	65	28.5 (4.4)	55	193 (32.9)	0.87 (0.34)

Source: Survey conducted by author in Bambamarca, Peru, 2000.

Note: The hat price is determined by the following formula: $P_h^p = bP_i + aw$. Where “b” is the input requirement per hat, so $b=1$ kg for any type of hat. Standard deviations are in parentheses.

* λ_2 and λ_1 are the marketing margin for hat traders and straw traders, respectively.

It is important to highlight that labour return variable, w , is equivalent to the value of labour marginal product. The analysis of labour return according to hat qualities reveals that considering a total sample of 259 hat makers, about 85% are engaged in the manufacture of low quality hat. Important differences in the level of labour return according to hat qualities are identified.

Table 9 suggests that the use of high-quality straw is to a great extent defining the direct relationship between hat quality and labour return. A labour return raw differential of 0.278 log-points (32%) in favour of high quality hats was estimated. In order to assess whether hat maker characteristics such as education, age²⁸, gender and distance to the market, have any role in explaining the differences in labour return, an Oaxaca decomposition (1973) was computed²⁹. This procedure is used to determine the portion of the differences in labour return between two groups of workers that is due to individual characteristics – the ‘explained factors’ – and the proportion of the difference in labour return that can be attributed to hat quality or access to a high-quality straw, the ‘unexplained factors’. Labour return variable was divided into two groups: hat makers that manufacture high quality hats and low quality hats. Results indicate that only about 10-22 percent is due to differences in gender, age, and education of the hat maker and distance of the household to the main market centre, while the remaining 78-90 percent is explained by the hat quality differential. So, it can be concluded that the type of input used in hat making matters in defining the value of labour productivity.

In comparing the labour return with two alternative wages rate per hour, the farm wage at the local village (S/. 0.625 per hour) and a proxy of the subsistence

²⁸ The variable years of experience in hat making activity was only collected for the head of the household. Age in years of every household member engaged in hat making was used as a proxy for experience, which was thought to be reasonable since the correlation coefficient between age and experience of the household head was 0.59 at the 1 percent level of significance.

²⁹ This method is named after Ronald Oaxaca, who popularised the decomposition by using it to study labour market discrimination. For further background reading on determinants of wages and wage discrimination measures, see Berndt (1991).

wage based on the extreme poverty line for rural areas in Peruvian Sierra (S/. 0.47 per hour), it was found that: i) in the sample, labour return per hour is higher than the subsistence level wage; ii) a different scenario emerged when labour return was considered according to hat quality. Low quality hat makers were receiving a labour return closer to the subsistence wage rate. In contrast, in the case of high quality hat makers, their labour return is 85% higher than the subsistence wage. This suggests that using low quality input and, therefore, making low quality hats is directly associated with low value of labour productivity.

In general, based on the previous analysis, the following relationship among above-mentioned wage rates per hour is identified:

$$w_{high} > w_{farm} > w_{low} \cong w_{sub} \quad (11)$$

where:

w_{high}	=	Labour return per hour of high-quality hat maker
w_{farm}	=	Farm wage per hour in local village
w_{low}	=	Labour return per hour of low-quality hat maker
w_{sub}	=	Subsistence wage rate per hour for Peruvian Sierra

This result provides evidence that the low-quality hat makers would be approaching to the shut-down condition since hat making hardly provides the minimum requirements for household maintenance.

Bambamarca illustrates the case of villages engaged in traditional rural industry that contributes to the family income and takes significant time of the household members. The favourable scenario would be that a hat maker has access to high quality input. Therefore, the underlying issue is how to transform goods of low quality goods into modern goods with steady demand in regional and national markets. Restrictions on the supply side hindering this transformation would be related to: i) the lack of access to credit for the timely purchase of better quality straw. From the survey questionnaire was possible to identify some evidence on the access to credit. During 1999/2000, only one household had access to credit offered by a local NGO (Non-Governmental Organisation). As it can be noted, for the vast majority of the hat producers, hat revenue is the only source for purchasing input. Given this context, the most important producer's expectation about improvement in hat making is related to the access to credit in order to buy a better quality input. Underlying this fact is the strong relationship between access to a better quality input and a higher labour return. ii) The presence of few hat traders who collude to fix the price at the producer level. This fact means that an increase in input cost is not reflected in a higher producer price; in contrast it is expressed in a fall in labour return.

4.- A typology of Non-Farm Rural Activities for peasants households

Table 3 confirms a diversification income strategy carried out by peasant households in the North Highland region of Peru. Outstanding differences are found regarding the role played by the non-farm income sources. Based on the analysis of rural household income sources, a NFRA typology is proposed in this section. This classification includes NFRA with potential and NFRA as a marginal or secondary complement to income.

Table 10 compares the demand for productive investment according to activity and typology of RNFA. For RNFA type II, agricultural and livestock income is the main source of household income. On the other hand, the production of processing and craft activities are mainly for domestic consumption or sales restricted to the community. It means that RNFA have not potential to generate income and this is shown by the lack of investments for this activity. Considering these results, it is not just a coincidence that the demand for productive investments is focused on improvements for agriculture and cattle breeding, standing out demands such as the access to credit, purchase of cattle, reforestation, channel building and offer of training courses in agricultural practices.

The evidence suggests that households with RNFA type I, productive investments in both farm and non-farm activities are demanded. This fact confirms the role played by agriculture and livestock as food supplier for household self-consumption; becoming, therefore, the RNFA as the main source of household monetary income.

Table 10. Demand For Productive Investment According to Activity

Type of Non-Farm Rural Activity	Agricultural Activity	Non-Farm Rural Activity
Type I: With Potential	-Access to credit -Improved seeds -Technical assistance	-Credit for input purchase -Improvement in technology -Market information: Local and foreign
Type II: Marginal	-Access to credit -Purchase of dairy cows -Reforestation -Training courses -Construction of irrigation canals	No demands

Source : Survey conducted by author in Bambamarca, Peru, 2000.

Due to the complexity of the peasant economy and in order to identify the relevance of the NFRA, it is proposed to consider the following level of analysis: a) the household unit level, it could be argued that the non-farming incomes depend on the possession of and/or access to physical assets (land, capital goods) by each household, financial, organizational assets, human assets (education, migratory experience), as well as access to specific goods and public services. b) The market level analysis which allows exploring the limitations and obstacles hindering the expansion of traditional non-farming rural activities by analyzing the market demand and supply of goods and services provides by NFRA. It is also important to study the NFRA linkages with the other markets, and specially, how the macroeconomic context affects the expansion possibilities of such activity. C) The third level of analysis focus on interventions within the framework of programs for poverty reduction.

a) At the domestic unit level, the rural household will be taken as reference of analysis. Within the context of poor rural households, it can be stated that the non-farming incomes depend on the possession of and/or access to physical assets (land,

capital goods) by each household, financial, organizational assets, human assets (education, migratory experience), as well as access to specific goods and public services (Ellis,1999).

The relations to be considered are:

- Family socio-demographic characteristics.
- Activities of the producer and his family: Family labor allocation to farming and non-farming activities.
- Possession of assets: human capital, physical capital, natural capital, financial capital and capital stock.
- Income sources: farming, fishing, processing, trade, remittances and wage incomes.
- Structure of family consumption, saving, investment, credit experience, among others.
- Relation with raw material markets and factors.

b) Analysis at market level, mainly of partial equilibrium. This will allow us to know the limitations and obstacles hindering the expansion of traditional non-farming rural activities by analyzing the market demand and supply of goods. It will be also important to study the NFRA linkages with the other markets, and specially, how the macroeconomic context affects the expansion possibilities of such activity.

c) Interventions within the framework of programs for poverty reduction.

When the role of the NFRA in poor rural families is analyzed, it must be identified if it is **feasible** to modify the current labor conditions, that is, to improve the labor training level, as well as the payment received. The actual problem is how to increase labor productivity in these activities, considering that all the family members take part in them and they will face different opportunity costs. What is the most important is transforming the goods from a low-quality good that has local demand by low-income consumers into higher quality goods with guaranteed or growing demand in external, national and regional urban markets. It is essential to get to this reflection level since it will allow to appropriately determining the priorities in the investment programs aiming at reducing poverty.

Different conclusions can be drawn, for instance, assuming that NFRA is feasible but it requires a specific set of change both at household and market level. In this situation, the factor for the NFRA growth may be external such as public investment in the provision of productive and social infrastructure, or dynamism of local or regional markets. Or perhaps, it is concluded that NFRA is irrelevant in economic terms and any effort to improve them will not have the expected result, so it is recommended to promote agriculture or cattle breeding. Thus, it is fundamental to identify the productive investment demands of rural households and evaluate them with the characteristics of their provision and access to assets.

Another key idea related to the reduction of poverty is considering the macro context where peasant families develop. Reducing poverty requires a stable and permanent macroeconomic environment, even though the economic growth is a necessary condition but not sufficient to reduce poverty. So, when the trickle down effect does not guarantee that the poor will receive the same benefits, political measures and interventions facilitating a significant increase in the income and the access of assets to the poor sectors, should be offered.

5.- Conclusions

This paper has investigated both theoretical and empirical issues related to non-farm rural activities in the context of a peasant economy located in a backward region in the Peruvian Sierra. Two specific subjects have been dealt with. Firstly, the importance of access to assets in explaining both farm and non-farm incomes was examined. Secondly, in the case of a home-based and traditional rural industry namely hat-making, options of activity expansion and identification of constraints were explored.

The key question addressed at the household level analysis was: What role does access to assets, private and public, play in explaining farm and non-farm incomes in the context of an Andean peasant economy?

A separable household model was used as the theoretical basis for the estimation of farm and non-farm income function. Assets were classified as natural, human, physical, financial, social, location and infrastructure, and political and institutional. In general, the estimation of farm and non-farm incomes has demonstrated the importance of assets such as natural, physical, human, social and location as positive determinants of rural incomes in Bambamarca.

The second research question to be addressed was as follows: What are the restrictions to the achievement of a rise in incomes in the context of a traditional rural industry? The selected approach for investigating this issue was a market analysis, covering both demand and supply aspects.

The hat making activity in Bambamarca illustrates the case of a traditional rural industry with strong demand linkages to a farm economy. In such a context it has been identified that the expansion of the activity faces demand and supply side constraints. This outcome contrasts with the general optimism expressed by current literature on the rural non-farm economy that suggests that this may be an important source of jobs and incomes for rural development and poverty alleviation. However, based on the empirical findings of this paper some caution should be taken on this issue. Firstly, the type and nature of linkages between the rural non-farm activity and the rest of the economy should be identified properly. Secondly, the nature of the product offered by the rural industry has to be assessed adequately. The extent to which the supply side can adjust to the demand side requirements is an important element with which to judge the relevance and feasibility of any rural non-farm activity for employment creation and income generation.

Appendix³⁰

The case of hat making activity: Hat price determination

A hat maker household produces a hat, q_h , using straw from Ecuador (*paja de palma*, I), and family labour, L , with output given by a Leontief production function, $q_h = \text{Min} \{L/a, I/b\}$, where “a” and “b” are the labour and input technical coefficients, respectively. In order to simplify the analysis, it is assumed that labour, straw and hats are homogeneous; this means that there are no quality differences in factor use and output³¹.

There is no credit market for hat making, so family revenue is the only source of input acquisition. The hat traders fix the hat price, P_h^p , at the hat maker level. The total cost of production, TC , given by the straw cost and the imputed value to family labour is equal to the total hat maker revenue (R). P_i is the straw price and “w” is the labour return per hour (equation 1).

$$R = P_h^p q_h = TC = P_i I + wL \quad (1)$$

An alternative way of looking at equation 1 is to consider the hat maker household as a consumer. In this situation, the total revenue is allocated between the purchase of hat input and the family expenditure (FE)

$$R = P_h^p q_{hi} = TC = P_i I + FE \quad (2)$$

The difference between equation 1 and equation 2 is summarized in:

$$FE = wL \quad (3)$$

It can be established that there is a key direct relationship between the imputed value of total family labour allocated to hat making and the level of family expenditure. So, FE can be considered as an indicator of household welfare.

The supply at the hat maker level is defined by equation 4, which is obtained by substituting the optimal levels of labour and input, resulting from the production function.

$$MR = MC = P_h^p = bP_i + aw \quad \text{for } q_h \leq q_h^* \quad (4)$$

Marginal revenue (MR) and marginal total cost (MC) are equalised to the hat maker price level, assuming that current level of hat product is less than full employment production, q_h^* , production reached when total family labour is used in hat making. There is a constraint to the level of imputed labour value, w . The situation in which $w \leq 0$ is not a feasible one. So, in order for hat making to be a viable activity, the level of labour return must guarantee a minimum access to food items.

In relation to the straw market, equation 5 describes the straw price function, P_i .

$$P_i = P^* e(1 + \lambda_1) \quad (5)$$

The input is a tradable commodity imported from Ecuador. The price depends on border input price in US dollars, P^* , the nominal exchange rate, e , and the trader

³⁰ A full explanation of the market model is found in Velazco et. al (2006).

³¹ This assumption, related to the final output, is later relaxed when considerations on hat quality are taking into account.

marketing margin, λ_1 . The straw demand is defined directly by the level of hat output, $I^d = bq_h$.

Family labour is allocated exclusively to hat making. Given a total family labour supply, $L^s \geq L^d$, it is expected that most of family members will be involved in this activity following the requirements of the labour demand function, $L^d = aq_h$.

Substituting equation (5) into equation (4), and re-arranging in terms of w , the determinants of labour return are expressed in equation (6). It is affected negatively by changes in input price components, and positively by hat price, assuming technological parameters fixed.

$$w = \frac{P_h^p - [P^* e(1 + \lambda_1)]b}{a} \quad (6)$$

The hat-trading component is summarised as $P_b^t = P_b^p(1 + \lambda_2)$. The price at the hat demand level, P_h^t , depends on the price paid to the hat maker and the marketing margin, λ_2 .

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