Chapter 2

Mobile phones as a tool in the household production process Evidence from Puno, Peru

Roxana Barrantes
Instituto de Estudios Peruanos[1]
roxbarrantes@iep.org.pe

Abstract

In less developed countries, mobile phones are the chosen means to access telecommunication services, particularly among the poor. In rural areas, usually lacking fixed telephony and public phones, there was a delay in mobile phone expansion and, consequently, adoption. Moreover, poverty is concentrated in rural areas, so as to render them unattractive for commercial service expansion. In spite of these difficulties, mobile phones are widely used in rural areas, although subscription to prepaid phones lags behind and post paid service is almost non existent. The discrepancy between use and subscription is explained by the widespread offering of mobile calls by street vendors, in fact using them as the regular public phone. Using evidence gathered in the area of influence of two rural markets in Puno, Peru, where livestock husbandry is more important than agricultural activities, this paper will identify how mobile phones are used by rural producers, trying to explain the impact their use has had in farm profits. Factors such as familiarity with ICTs, experience, length of mobile phone use, household commercial orientation, importance of agriculture *vs* livestock husbandry, family size and composition, among others, will be discussed and evaluated econometrically. In so doing, we will examine the role the mobile phone currently plays.

Keywords: mobile phone use, agriculture, LDC

[1] I would like to thank IEP researcher Ramón Díaz for initial discussions, which helped me define the approach, and Ramiro Burga, who pursued the econometrics. Mireia Fernández-Ardèvol, Jonathan Donner and Francois Bar provided useful comments and recommendations. The map was drafted by Oscar Madalengoitia. The usual disclaimer applies.

Introduction

In less-developed countries, mobile phones are the preferred means of access to telecommunications services, particularly among the poor. In rural areas, which usually lack fixed telephony and public phones, there was a delay in the expansion and, therefore, adoption of mobile phone service. In addition, poverty is concentrated in rural areas, making them unattractive for commercial service expansion. Despite these difficulties, mobile phones are widely used in rural areas, although subscription to pre-paid phones lags behind use, and post-paid service is almost non-existent. The discrepancy between use and subscription is partly explained by the widespread availability of mobile call service offered by street vendors; this service is essentially a substitute for public phones.

Using quantitative evidence gathered in the area of influence of two rural markets in Puno, in southern Peru, where livestock raising is as important as crop farming, this paper aims to identify how farmers use mobile phones, examining the impact of "directly productive" uses, such as communicating with clients, suppliers or producers' associations, on agricultural profits. Based on previous work (Barrantes, et al., 2009) which examined the effect of mobile phone use on household welfare, this paper focuses on the productive side of the agricultural household, and does not consider the possible contribution to family welfare of the inclusion of household members in labor markets.

As the paper indicates, the evidence shows no strong effect of mobile phone use on profits from either livestock or crops, although the econometric results for livestock are more reliable than those for agriculture. Variables such as the household's commercial orientation or the vertical integration of the production process show greater importance. Because mobile phone use is very recent for these producers, the median length of use being 12 months, information relevant to *production processes* that is

gathered by using the mobile phone does not yet have a significant impact on either crop or livestock production.

The structure of the paper is as follows. This introduction is followed by a brief description of the study area. The next section describes the main elements of the analytical framework. Econometric results are presented in the fourth section. The paper ends with final comments and pending research questions.

Description of the study zone

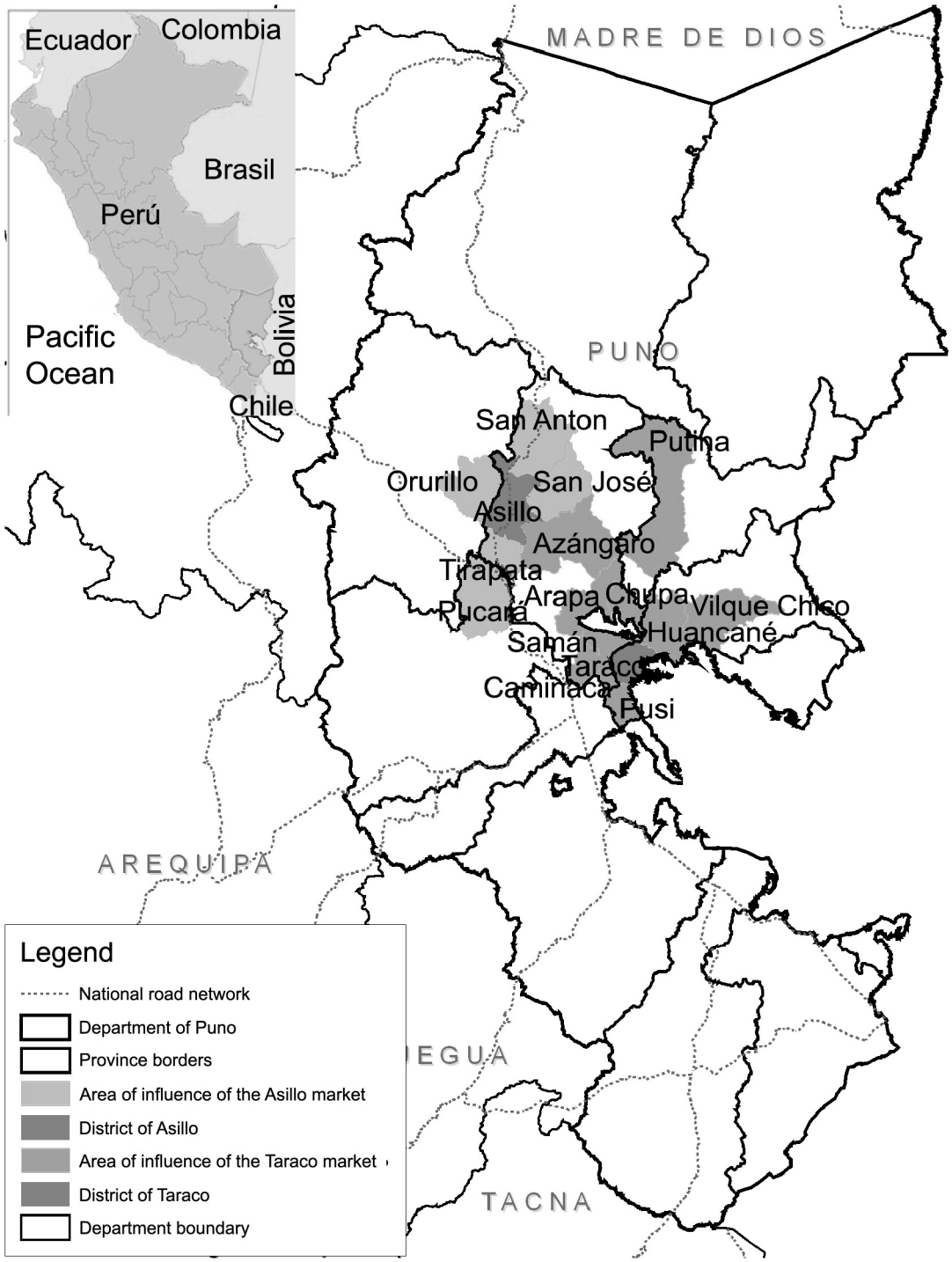
The information used in this study was collected in June and July 2008 as part of the study of "Mobile Communications and Development in Latin America" funded by the *Fundación Telefónica* and led by the UOC. A random sample of homes was chosen in the areas of influence of two markets in the Puno region, in southern Peru (see Map 2.1), to evaluate the impact of the introduction of mobile telephones on daily life in rural homes. One person between ages 13 and 70 was randomly chosen from each household to learn about mobile phone use. This informant was given an additional questionnaire about the use of mobile phones and other ICTs in general.

The markets were chosen controlling for similar key characteristics: altitude and population. Altitude is a very important geographical constraint in the area of the Collao Plateau, which is part of the Lake Titicaca ecosystem.[2] Local altitudes on the plateau exceed 3.500 meters above sea level. Unlike the rest of the Peruvian Andes, it is basically flat, with few of the steep slopes that make productive activity difficult. Although the slopes are relatively gentle, households in this area of Puno face extreme weather conditions during the day and/or throughout the year. In winter, they suffer ground frost, which hits them hard and for which they are not prepared. Besides geography, the study looked for similarities in the size of the villages, measured by

[2] See Parodi (1995).

number of inhabitants, and the poverty level of the households, using unmet basic needs as the indicator.[3] The markets were chosen based on those three basic criteria.

Map 2.1. Puno and the areas of influence of the Asillo and Taraco markets



[3] See Feres y Mancero (2001).

The markets chosen were in Asillo and Taraco, in the provinces of Azángaro and Huancané, respectively. From Juliaca, the commercial capital of Puno, it takes about an hour to reach either of them on a paved road.[4] Asillo's market day is Sunday, while the Taraco market is on Thursday. Both are held from 5 am. to 3 pm. Six districts were identified in the Asillo market area and 10 in the area near the Taraco market.

Table 2.1 shows the poverty indicator based on the number of unmet basic needs (UBN) for the households in the sample surveyed for the qualitative study. Three of every four households have at least one UBN, which is well above the national-level indicator.

Table 2.1. Unsatisfied Basic Needs (UBN) in the study area

Indicator	*Sample**	*Asillo**	*Taraco**	*Puno***	*Peru***
No UBN	24%	20%	27%	26%	41%
1 UBN	33%	33%	32%	20%	19%
2 UBN	29%	28%	30%	24%	18%
3 UBN	11%	15%	8%	18%	14%
4 UNB	3%	4%	3%	10%	8%
5 UBN	0%	0%	0%	1%	1%

Source: * Survey (Barrantes, 2008) and ** ENAHO (National Living Standards Survey) 2007, for Puno and Peru.

Framework for analysis

It is widely recognized that in developing countries, mobile telephony, chiefly for low-income sectors and rural areas, has given people their first opportunity to access telecommunications. When people use mobile telephones, they obtain information and lower the costs of communicating, helping them establish more solid position in markets, gain access to new markets, and increase their income by reducing losses from price dispersion.

Jensen (2007) conducted the study that has had the greatest impact on knowledge of the effects of mobile telephones, by demonstrating that rent dissipation caused by incomplete information is reduced by using mobile telephones, which supports the law

[4] Both villages can be reached from Lima via Juliaca (San Román province), which has an airport. The flight takes about an hour and a half. Once in Juliaca, visitors can travel to Asillo by public transportation (bus). The fare is S/.4,00 Sol (US$ 1,30) and the journey takes about two hours. Visitors can travel to Taraco from Juliaca by rural vans (called "combis"), a trip that takes about 45 minutes and costs S/.2,50 (US$0,83).

of a single price and the efficient working of markets. Similarly, In Niger, Aker (2008) found that the use of mobile telephones reduced price dispersion in the grain market; the decrease was greater in more remote markets with less access. It is important to note that these two studies focus on the role of the information mobile telephones provide in commerce, not in production per se.

Esselaarc et al. (2007) studied the impact of ICTs in small businesses and microenterprises in 13 countries in Africa. The main finding was that these technologies are highly productive inputs, because they reduce transaction costs and provide greater market access both for the formal and informal sectors. They stress the use of mobile phones, reporting an immediate benefit because they are easy to use and are widely available.

As in other research (Galperin and Mariscal, 2007; De Silva and Zainuden, 2007), this study distinguished between the owner of the telephone (subscriber) and the user. Due to affordability constraints, the user may not necessarily be the subscriber. In fact, survey figures show that 76 percent of interviewees are service users, and of these, just two-thirds are subscribers. The telephone is shared by members of one family or by various friends. There is also a considerable supply of calls through mobile phones for public use, by street vendors or *chalequeros* who offer the service, or through phone booths or telecenters.[5]

This study begins with a simple household production function model, to explain not the level of production, but the level of profit from livestock and crop farming. While the interaction between those activities is recognized, this study separates the estimated profit from crops from the profit from livestock. In each case, direct sales and by-products are added. While the former constitute a primary activity, the latter represent processing, which gives greater added value to primary production.

[5] *Chalequeros* are people who hire out mobile telephones by the minute. They usually work in village squares or on busy street corners and they wear bright-colored vests (hence the name, which comes from the Spanish word for vest, *chaleco*). Their rates are lower than public telephone and pre-paid phone rates.

Profit (the difference between revenue and costs) is therefore due to two factors: production and marketing. In the area of production, I argue that profit depends on the level of certain stocks of human and natural capital. Marketing management is also the outcome of decisions linked to stock flows, reflected in the degree of insertion in markets. Besides these variables, which are typically discussed in the literature, and which explain small farmers' production decisions and outcomes, this study also includes characteristics and perceptions of the use of mobile phones for obtaining information for production and marketing decisions. The variables, their definitions and the underlying hypothesis are summarized in Table 2.2.

The variables chosen to reflect human capital stock are: total size, indicated by the number of household members; the proportion of adults, which reflects the importance of the most productive labor; and accumulated human capital, based on the educational level of the household member with most years of schooling.

I also consider variables associated with the use of the mobile telephone as a production input: being a mobile phone user; using the mobile phone to communicate with clients, suppliers or producers belonging to associations, which indicates a connection with marketing decisions; using the mobile phone to obtain information about crop or livestock production, which indicates a connection with production decisions; or a perception that communication has improved with the use of the mobile telephone. The study examines how long the mobile phone has been used, a variable which turned out to be very important for explaining differences in levels of household welfare in the study area (Barrantes et al., 2009).

The models include a dummy variable that places the household in the area of influence of a particular market, with Taraco having a value of zero.

Table 2.2. Variables included in the econometric analysis

Variable	*Indicator*	*Type - Measurement unit*	*Definition / Hypothesis*
Endogenous variable	Agricultural profit	Continuous (Current Soles)	Agricultural profit is the difference between revenue and total agricultural expenditure. Agricultural revenue is the sum of the total value of agricultural production, the value of agricultural by-products and the total value of forest production. Agricultural expenditure is the sum of wages, animal and machine hiring and other inputs.
	Livestock profit	Continuous (Current Sols)	Livestock profit is the difference between revenue and total livestock expenditure. Livestock revenue is the sum of the value of sales from livestock activity (sale of animals) and the total value of livestock by-products.
Human capital	Number of household members	Discrete	The value of this variable is the total number of members in each household. A higher value is related to higher profits, because it minimizes the need to hire labor.
	Proportion of adults en in household	Continuous (between 0 and 1)	This ratio is the quotient of adults per household (between ages 15 and 65) divided by the total number of household members. A higher ratio means higher profit, reflecting a more productive labor force.
	Highest level of education achieved by a household member	Discrete Whole number	A household member with more education can have a positive impact on productivity.
Natural capital - Agriculture	Number of plots	Discrete Whole number	The value is the number of plots of the household. A higher number may be related to land fragmentation, which results in difficulties in achieving economies of scale. It could therefore be associated with low productivity, which negatively affects the level of agricultural profit.
	Average plot size	Continuous (Hectares)	A smaller average plot size may adversely affect productivity and thus the level of agricultural profit
	Number of crops	Discrete (Whole number)	A larger number of crops in the portfolio is expected to be associated with lower levels of agricultural income and difficulties in specialization, which makes it more difficult to achieve economies of scale.

Natural Capital – Livestock production	Number of species	Discrete Whole number	The number of species of animals raised by the household. A higher number of species shows greater diversification and thus a reduced risk, which can have a positive impact on livestock profit level.
	Number of head of the main animal	Discrete Whole number	The main animal is the one that contributes the greatest added value associated with livestock. A larger number of animals is expected to be associated with greater livestock profit.
Productive results and market orientation - Agriculture	Value of production of fodder crops per hectare tilled (including own and rented)	Continuous (Current Soles)	Higher value implies greater productivity, and greater agricultural profit is therefore expected.
	Ratio: Value of fodder crops / Total value of agricultural production	Continuous (between 0 and 1)	For greater integration of crops and livestock, the importance of fodder crops may reflect vertical integration and be associated with higher profit levels.
	Ratio: Value of production devoted to making agricultural by-products / Total value of agricultural production	Continuous (between 0 and 1)	This ratio reflects the importance of vertical integration and may reflect higher profit levels.
	Ratio: Value of main crop / Total value of agricultural production	Continuous (between 0 and 1)	Indicates greater specialization and is related to higher productivity and profit.
	Livestock raising household	Dichotomous = 1 if agricultural household	If a crop-farming household also raises livestock, the result could be risk reduction through diversification, but also higher diversification and difficulties in achieving economies of scale.
Production outcomes and market orientation – livestock production	Value of fodder production per hectare tilled (including own and rented)	Continuous (Current Soles)	Higher value implies greater productivity, so higher livestock profit is expected.
	Importance of by-product sales compared to total added value of livestock production	Continuous (between 0 and 1)	This ratio shows the relative weight of livestock by-products in the total added value. This may be related to greater productivity and thus be associated with higher levels of livestock profit.
	Importance of main by-product sales compared to total livestock by-product sales	Continuous (between 0 and 1)	Indicates greater specialization and is related to greater livestock productivity and profit.

Mobile phone as production input	Informant is mobile user	Dichotomous = 1 if representative is mobile user	Presence of mobile users in household helps in conveying information and knowledge.
	Dummy – used mobile to get information about … --either agricultural crops or livestock production	Dichotomous = 1 if mobile was used for that purpose	Multiplicative variable that establishes interaction between the variable “use of information from third parties for agricultural production” and the variable “use of mobile phone for obtaining information”.
	Length of time mobile phone has been used	Continuous (months)	Having used a mobile phone for a longer time reflects greater familiarity with it and knowledge of its use. This may help in obtaining information.
		Categorical - Under 1 year. - From 12 to 24 months - Over 24 months	
	Used mobile phone to communicate with clients, suppliers or members of producers’ associations (dummy)	Dichotomous = 1 if mobile was used for that purpose.	The variable considers the informant who uses the mobile phone to communicate with clients and/or suppliers and/or members of producers associations or cooperatives. Decreased transaction costs can have a positive effect on the levels of profits. In the OLS models, only communication with clients or suppliers is considered. The IV models add communication with members of producers’ associations or public agencies.
	Dummy if perceived improvement in communication	Dichotomous =1 if communication is perceived to have improved a little or greatly	If the informant perceives improvement in communication, this may signal full integration of the mobile phone into everyday activities.
Location	Market	Dichotomous = 1 if the market is in Asillo.	A location variable.

In the case of natural capital, crop farming is distinguished from livestock raising. For crop farming, the study considers average farm plot size, which indicates the possibility of achieving economies of scale in production; the number of plots, which reflects both a possible strategy for reducing climate risks and the division of land, which is an obstacle to the increases in efficiency that are possible with a higher productive scale; and the number of crops, which shows crop diversity and risk reduction, as well as a lack of specialization, which can negatively affect profit.

Market orientation and production results are measured by various ratios. First, as an indicator of the importance of primary activities, is the relative importance of crop sales in total sales. Second is the relative importance of crop production for making agricultural by-products, which shows vertical integration; and the proportion of fodder crops in total agricultural production. The third factor is the importance of the main crop as an indicator of specialization and possible associated efficiencies.

The analysis of livestock raising differs from that of crop farming in the definition of natural capital variables and the ratios that reflect market orientation. As natural capital variables, the study considers the number of species of animals, which is an indicator of diversification and risk reduction, but which is also an obstacle to obtaining the benefits of specialization; the number of head of the most valuable kind of animals, as an indicator of productive specialization; and average pasture size. The variables used to analyze market insertion reflect the relative importance of certain types of production: livestock value compared to total added value, as an indicator of the importance of primary activities; the value of the main species compared to the total for all livestock, as an indicator of specialization; the importance of fodder crops; and the value of the main by-product as a percentage of all by-products.

Empirical analysis

This section presents the results of the econometric analysis in light of the framework for analysis described above. The analysis separated households that stated that their permanent activity was crop farming (699) from those that said they were dedicated to raising livestock (690). There could be some overlap, because the two activities tend to be complementary for rural families (667 households). The descriptive statistics for all variables used can be found in Appendix 1.

Crop farming profit

The hypothesis is that the level of profit from crop farming, either total or per plot, depends on the levels of human capital and natural capital stock, the degree of specialization and market orientation, and the use of mobile telephones to facilitate access to information and reduce overall transaction costs.

Table 2.3 shows the results from the proposed models. The first three correspond to all crop-farming households (N=767), including those that stated that crop farming was not their permanent activity, while the last two correspond only to those in which the informant is a mobile telephone user and is the head of household or spouse. When all households are considered, the key point is the difference between users and non-users of mobile telephones; when considering only informants who are users and heads of households or spouses, the key point is differences in use.

The results show the importance of the effects of specialization on productivity: higher profits are associated with larger plots and with households in which there is a greater value of fodder crops per hectare. The number of plots is also important in explaining profit levels, indicating the possible risk-reduction effects of multiple plots in context characterized by adverse climate and limited insurance availability.

Table 2.3. Agricultural profit – OLS models

	Model # 2.3.1		Model # 2.3.2		Model # 2.3.3		Model # 2.3.4		Model # 2.3.5	
Endogenous:	Agricultural profit		Agricultural profit per plot		Agricultural profit per plot		Agricultural profit per plot – informant is head of household or spouse and user of mobile phone		Agricultural profit - informant is head of household or spouse and user of mobile phone	
Number of household members					14,1132 (9,2147)					
Proportion of adults in household	510,5162 (354,7296)		61,4969 (72,9625)		112,5528 (75,6734)		84,4926 (87,6469)		607,1671 (421,9570)	
Ratio: Value of main crop / Total value of agricultural production	699,3610 (448,9960)		-131,4520 (89,5381)		-126,6564 (89,5814)		148,3519 (110,3178)		1.401,1770 (549,7323)	**
Value of agricultural production of fodder per hectare tilled (including own and rented)	1,0876 (0,1989)	***	0,2262 (0,0381)	***			0,2830 (0,0527)	***	1,3455 (0,2055)	***
Value of agricultural production of forage per hectare tilled if livestock household					0,2218 (0,0403)	***				
Number of plots	677,6272 (58,8503)	***							534,4173 (74,2358)	***
Average plot size	421,0784 (178,4783)	**	111,9158 (44,1138)	**	104,3512 (42,5118)	**	320,2877 (66,5496)	***	1.209,9940 (245,4629)	***
Livestock raising household									-3,688,185 (229,9577)	
Length of time mobile phone has been used, if informant is head of household or spouse	-1,3612 (8,7354)		1,8991 (2,5968)		2,0854 (2,6670)		2,2222 (2,7324)		4,0773 (7,8563)	
Mobile phone used to obtain information about agricultural crops			28,3621 (49,7947)		73,2900 (111,2036)		3,7138 (57,4677)		408,5321 (382,8477)	
Mobile phone used to get information about agricultural crops, if informant is head of household or spouse					-61,7582 (125,3920)					
Perception regarding improved communication (improved a little greatly)					-176,7295 (145,3327)					
Mobile phone used to communicate with clients and suppliers	659,0047 (456,5201)		66,8223 (78,5142)		156,6164 (139,6416)		-6,0665 (64,4890)		172,9772 (323,3386)	
Informant is mobile user	1.187,0310 (541,5273)	**	111,2556 (98,1718)		161,7251 (156,6993)					
Market	-1.352,0330 (242,3780)	***	-235,4757 (45,6550)	***	-255,1640 (46,6980)	***	-216,5260 (54,9264)	***	-1.070,9990 (212,6658)	***
Constant	-3.234,8010 (768,0891)	***	218,6216 (123,6413)	*	91,6413 (175,1081)		-29,2691 (130,7094)		-2.510,7760 (703,9604)	***
Goodness of Fit Statistics										
Number of obs.	767		767		767		429		429	
Degrees of freedom	9		9		12		8		10	
Chi-square test – Overall significance	38,35 0,0000˜	***	34,43 0,0000˜	***	26,42 0,0000˜	***	19,59 0,0000˜	***	23,46 0,0000˜	***
Akaike's Information Criterion (AIC)	14.185,11		11.571,67		11.590,80		6.399,73		7.742,19	
Bayes' Information Criterion (BIC)	14.231,54		11.618,09		11.651,16		6.436,29		7.786,87	
R^2	0,5124		0,4341		0,4243		0,4976		0,5766	

Standard errors in parenthesis: *** Significance level = 0,01. ** Significance level = 0,05. * Significance level = 0,1.

Only in the total household sample does being the user of a mobile phone have the expected sign and statistical significance. In the models in which the variable “use of a mobile for obtaining information about crops” was included, it showed the expected sign, but was not statistically significant. The additional step in mobile phone use, both the perception of better communications and the use of the mobile phone to communicate with clients and suppliers, yields weaker results: not only are they not statistically significant in any of the models, but they also have different signs, depending on the model. Finally, the length of time the person has used a mobile telephone is not statistically significant in any case and shows the expected sign, except in Model 2.3.1, in which being a user is statistically significant.

These models may reflect problems with the endogenous variables. For example, using the mobile phone to call clients and suppliers could be the result, rather than the cause, of high agricultural profits. To solve this problem, the instrumental variables model was used.

In the two-stage least square (2SLS) instrumental variable model, the endogenous regressor was modified from the one considered in the simple OLS models shown above. Besides calls to clients and suppliers, mobile phone calls to producers’ associations and cooperatives or similar businesses were also included. Three instruments were used: the perception of improved quality of the mobile phone call, length of use of a mobile phone, and owning a mobile phone.

Table 2.4. Agricultural profit - Instrumental Variables models

	Model # 2.4.1	Model # 2.4.2	Model # 2.4.3	Model # 2.4.4
Endogenous:	**Agricultural profit if informant is mobile phone user and head of household or spouse**			
Explanatory:				
Mobile phone used to communicate with clients and suppliers, similar business, producers' associations or support agencies	0,5210 (0,2790286)	0,5937 ** (0,2890574)	0,4410 * (0,2559228)	0,3713 (0,2677258)
Number of household members		0,0212 (0,0181186)		0,0178 (0,0165125)
Proportion of adults in household	0,1240 (0,0943516)	0,2478 ** (0,1080475)	0,1256 (0,0931112)	0,2089 * (0,1098572)
Highest level of education reached by a member of household		-0,0247 *** (0,0093095)		-0,0167 * (0,0088895)
Highest level of education reached by a member of household if that person is the informant	-0,0064 (0,0046856)			
Ratio: Value of production used to make agricultural by-products/ Total value of agricultural production		0,1615 (0,1942763)		-0,0971 (0,1677873)
Ratio: Value of main crop / Total value of agricultural production	-0,0175 (0,1386259)	-0,0715 (0,1421473)	-0,0056 (0,1358443)	0,1299 (0,1413592)
Value of fodder production per hectare tilled (including own and rented)				0,0003 *** (0,0000312)
Ratio: Value of fodder crops/total value of agricultural production	0,7705 *** (0,079073)	0,8369 *** (0,0924443)	0,7791 *** (0,0781089)	
Number of plots	0,1117 *** (0,0140388)	0,1161 *** (0,0204203)	0,1133 *** (0,0137951)	0,1310 *** (0,0176197)
Average plot size	0,1591 *** (0,0511088)	0,1786 *** (0,0548312)	0,1603 *** (0,051006)	0,2959 *** (0,0593088)
Number of crops		-0,0063 (0,0259621)		-0,0005 (0,02319929)
Livestock raising household		-0,1043 (0,0712896)		0,0601 (0,0601102)
Mobile phone used to obtain information about agricultural crops	-0,0396 (0,0831909)	-0,0311 (0,0884672)	-0,0458 (0,0792881)	0,0251 (0,0675103)
Market	-0,4645 *** (0,0517998)	-0,4752 *** (0,057483)	-0,4623 *** (0,0510231)	-0,2943 *** (0,0556519)
Constant	7,0290 *** (0,1457474)	7,1588 ** (0,1854407)	6,9860 *** (0,1422535)	6,8813 * (0,1905604)
Goodness of Fit Statistics				
Number of observations	431	431	431	431
Degrees of freedom	9	13	8	13
Cragg-Donald Statistic	8,459	7,919	9,678	7,865
F-test for overall instruments	1,71	2,09	1,56	0,86
Centered R2	0,5582	0,5505	0,5722	0,6333
Uncentered R^2	0,9965	0,9965	0,9966	0,9971

Instruments: Length of use of mobile phone, perception of improved quality, phone owner

	Stock-Yogo Critical Values:	
Standard errors in parenthesis	5% maximal IV relative bias	13,91
*** Significance level = 0,01.	10% maximal IV relative bias	9,08
** Significance level = 0,05.	20% maximal IV relative bias	6,46
* Significance level = 0,1.	30% maximal IV relative bias	5,39
	10% maximal IV size	22,30
	15% maximal IV size	12,83
	20% maximal IV size	9,54
	25% maximal IV size	7,80

The regression results are shown in Table 2.4 and reflect an acceptable level of global adjustment. The use of mobile phones to communicate with clients, suppliers and members of producers' associations shows the positive sign, as expected, in all models, and is statistically significant in model 2.4.2 For this model, further tests were run on both the coefficient bias, compared to the OLS coefficient, and instrument strength, yielding weak results.[6]

Risk-reducing strategies, indicated by the number of plots, and possible economies of scale, measured by average plot size, proved robust to model specification. The importance of livestock production in the area of study is shown by the statistical significance of the relative importance of fodder crops. Households in Taraco, which are closer to the larger Juliaca market, show higher profits.

Profit from raising livestock

As with profit from crop farming, the study proposes models to explain profit from raising livestock.

The first is a simple OLS model. Table 2.5 shows three adjusted models, which differ in the explanatory variables included and the universe studied. For model 2.5.1, total livestock-raising households were considered. For Model 2.5.2, only livestock raising households in which the informant used a mobile phone were analyzed; while for Model 2.5.3, only households in which informants were heads of household or spouses were considered. Although R2 is relatively low in all three cases, it is interesting to note that the other goodness-of-fit statistics are acceptable.

In Model 2.5.1, being a mobile user correlates positively to higher levels of livestock-farming profit. This is also true of the level of education of the best-educated member of the household, the degree of specialization in by-product production (measured by the importance of the major by-product as a proportion of total by-product production),

[6] Shown in Table 2.4 by the Cragg-Donald statistic (below the critical value for a 5% maximal IV relative bias), and by the F-Test for excluded instruments, which shows a *p-value* of 0,16.

and the total number of heads of the animal that is most important for sales. In contrast, greater importance of by-products in added value is related to lower profit from livestock raising.

Table 2.5. Models of Livestock Profit – OLS method

	Model # 2.5.1	**Model # 2.5.2**	**Model # 2.5.3**
Endogenous:	**Livestock profit**	**Livestock profit - informant is head of household or spouse**	**Livestock profit - informant is mobile phone user and head of household or spouse**
Highest level of education achieved by a household member	70,9779 ** (28,7802)	28,9478 (27,2707)	74,9378 (53,2074)
Ratio: Total value of livestock by-products / Total added value of livestock production	-761,7711 ** (323,8487)	-819,8313 * (367,9004)	-1.232,9180 *** (471,9218)
Ratio: Sales value of main by-product / total value of livestock by-products	1.310,1330 *** (261,9467)	1.378,1130 *** (311,5380)	1.555,034 *** (380,2768)
Value of fodder production per hectare tilled (includes own and rented)	0,2936 *** (0,0943)	0,2477 ** (0,1039)	0,4880 ** (0,1901)
Number of species	660,5056 *** (135,5916)	435,6414 *** (157,0612)	456,8256 ** (194,2129)
Number of head of main animal	2,6093 *** (0,4702)	2,0823 *** (0,1775)	2,2921 *** (0,1475)
Length of mobile phone use		30,9596 * (17,2876)	
Informant is user of mobile phone	895,4714 *** (187,9171)	488,5031 (187,9171)	
Market		69,0809 (265,9925)	
Mobile phone used to communicate with clients and suppliers			138,1331 (407,3590)
Constant	-1.108,526 *** (371,1239)	-271,9137 (350,1698)	117,6605 (500,7935)
Goodness of Fit Statistics			
Number of observations	704	550	394
Degrees of Freedom	7	9	7
Chi-square test – Overall significance	19,73 0,0000¨	83,98 0,0000¨	89,80 0,0000¨
Akaike's Information Criterion (AIC)	13.086,48	10.213,99	7.414,20
Bayes' Information Criterion (BIC)	13.122,94	10.257,08	7.446,01
R^2	0,1818	0,1752	0,1566

Standard errors in parenthesis: *** Significance level = 0,01. ** Significance level = 0,05.
* Significance level = 0,1.

Model 2.5.2, in which the informant is head of household or spouse, shows that being a mobile phone user is not as important as using a mobile phone for a longer time (length of use). The remaining variables behave similarly to Model 2.5.1 and Model 2.5.3. The

novelty in Model 2.5.3 is that it allows us to examine the type of call made by users who are heads of household or spouses. Calls to clients and suppliers were expected to be statistically significant in explaining the level of profit from livestock raising. While the resulting sign is the expected one, the variable does not show statistical significance.

As with crop farming, the OLS models may face the endogeneity problem, since it is reasonable to conclude that using the mobile phone to call clients and suppliers is the result, rather than the cause, of high levels of profit from raising livestock. To solve this problem, the study used the instrumental variables method. A larger set of possible sources of relevant information, besides clients and suppliers, was also included in the endogenous regressor (mobile calls to businesses, producers' associations or support agencies). As in the case of profits from crop farming, three instruments were included for the endogenous regressor: length of time of mobile phone use, perception of improved call quality, and being the mobile phone owner.

For these models, only households in which the informant was head of household or spouse and was the user of the mobile phone were included in the regression.

The results of the regressions, which take the natural logarithm of the dependent variable, are shown in Table 2.6, and reflect an appropriate overall goodness of fit for the three models. The use of mobile phones to communicate with clients, suppliers and members of producers' associations shows the expected positive sign in all models and is statistically significant in models 2.6.1, and 2.6.2. Further tests were run on both coefficient bias, compared to the OLS coefficient, and instrument strength, yielding strong results.[7]

[7] Shown in Table 2.6 by the Cragg-Donald statistic (barely below the critical value for a 5% maximal IV relative bias) and the F-Test for excluded instruments, which shows a *p-value* of 0,0544 and 0,0637, respectively.

Table 2.6. Livestock profit - Instrumental variable model

	Model # 2.6.1	Model # 2.6.2	Model # 2.6.3
Endogenous:	**Per capita profits when informant is user and head of household or spouse**	**Profits when informant is user and head of household or spouse**	
Explanatory:			
Mobile phone used to communicate with clients and suppliers, similar businesses, producers' associations or support agencies	0,4421 ** (0,220225)	0,4188614 * (0,2140277)	0,4199 (0,2728203)
Proportion of adults in household			-0,0719 (0,1053208)
Highest level of education reached by a member of household		0,0008 (0,0065935)	-0,0011182 (0,0084527)
Ratio: Total value of livestock by-products / Total added value of livestock production	-0,2284 *** (0,0753599)	-0,1779 ** (0,0694156)	-0,2609 *** (0,0795017)
Ratio: Sales value of main by-product / total value of livestock by-products	0,3001 *** (0,0619772)	0,3046 *** (0,06077)	0,2703 *** (0,0641184)
Value fodder production per hectare tilled (includes own and rented)	0,0001 *** (0,0000277)	0,0001 *** (0,0000281)	0,0001 *** (0,0000348)
Number of species	0,1233 *** (0,0271073)	0,1645859 (0,0295892)	0,1685 *** (0,0290531)
Number of head of main animal		0,0002 *** (0,0000782)	0,0002 ** (0,0000783)
Mobile phone used to obtain information about livestock production			0,2065 (0,1422137)
Market	0,1053 * (0,0611916)		0,0985 (0,0658553)
Constant	6,6230 *** (0,0800741)	7,7810 *** (0,0935405)	7,8026 *** (0,1122156)
Goodness of Fit Statistics			
Number of observations	418	420	395
Degrees of freedom	7	7	10
Cragg-Donald Statistic	13,355	12,399	9,11
F-test for overall instruments	2,56 *	2,44 *	2,96 **
Centered R2	0,1024	0,1916	0,2111
Uncentered R^2	0,9956	0,9967	0,9968
Instruments: Length of use of mobile, perception of improved quality, terminal owner		Stock-Yogo Critical Values:	
Standard errors in parenthesis		5% maximal IV relative bias	13,91
*** Significance level = 0,01.		10% maximal IV relative bias	9,08
** Significance level = 0,05.		20% maximal IV relative bias	6,46
* Significance level = 0,1.		30% maximal IV size	5,39
		10% maximal IV size	22,30
		15% maximal IV size	12,83
		20% maximal IV size	9,54
		25% maximal IV size	7,80

Insertion in fodder markets and specialization, reflected in the relative importance of the main by-product in total value added, are statistically significant and show the expected positive sign. Number of heads of livestock also positively influences the level of profits. In contrast to results for crop farming, livestock profits are not affected by market location.

Final comments

Using quantitative evidence gathered in the area of influence of two rural markets in Puno, in southern Peru, this paper shows the positive effect of mobile phone use on profits in rural households. Higher profits are explained by the use of mobile phones by heads of households or spouses who make calls to clients, suppliers, similar businesses, producers' associations or support agencies.

Nevertheless, the results are not as strong as initially expected, which could be explained by the distinction between the effects of mobile telephone use on marketing decisions and effects related to the production context. The underlying hypothesis is that the cost of looking for new markets for a particular product is lower than the cost of adopting new techniques, which may be associated with modification of the product. Information leading to product modification may take longer to permeate entrenched agricultural practices that have proven to reduce risk over the years. The possible positive effects of the use of mobile phones on profit – either in crop farming or livestock raising – occur first in marketing and are not yet manifested or perceived in defining parameters for production (obtaining information about crops or about raising particular animals).

This possible differentiated effect could mainly be a response to the fact that these decision-makers have used mobile phones for only a short time, an average of 16 months. During that time, they have made many more marketing decisions about the farm household's products or by-products than about production (decisions associated

with the crop cycle or animal reproduction cycle). It may be too early to assess the directly productive impact of mobile phone use.

Nevertheless, it is important to note the statistically differentiated effects observed when explaining agricultural profits compared to livestock profits. The latter appear more conclusive than the former. This could be because the production time frame is more flexible for livestock production than crop farming. The qualitative evidence showed that timely contact with a veterinarian was key to increasing livestock productivity; this was achieved by using the mobile phone. No similar key use of the mobile phone was documented for crop production.

On the other hand, emphasizing calls to clients and suppliers as an indicator of the productive use of the mobile telephone overlooks the fact that these households' information networks are crisscrossed by solid kinship relations in contexts in which market transactions have not yet permeated a wide array of activities, as they would in more modern or urban areas of the country. It is difficult to determine when a call to a relative stops being 'unproductive' and becomes a productive call (i.e., related to a decision about where to sell, price, inputs, etc.). Clearly this is an area for further investigation.

Appendix 1 – Descriptive Statistics

All monetary figures are expressed in Soles. Current exchange rate: 2.8 soles per American dollar.

Table A. 2.1 Agricultural profit. Total households engaged in agriculture: N = 767

Variable	*Average*	*Median*	*SD*	*Min*	*Max*	*% Yes*	*% No*
Agricultural profit	2.341,41	998	3.550,98	-1.171,50	25.625		
Number of people per household	4,20	4	1,84	1	11		
Proportion of adults in household	0,64	0,63	0,26	0	1		
Highest level of education reached by a member of household	10,44	12	3,63	1	17		
Number of plots	4,77	5	2,12	0	14		
Average plot size	0,60	0,40	0,91	0	15,5		
Number of crops	3,72	4	1,65	1	9		
Value of fodder production per hectare tilled (includes own and rented)	821,77	165	1.420,32	0	15.740,74		
Value of agricultural sales	58,50	0	400,82	0	10		
Total value of agricultural production	2.433,84	1.07	3.584,54	0	25.82		
Value of production devoted to making agricultural by-products	127,87	90	155,96	0	1.6		
Value of main crop	1.365,25	577	2.026,65	0	15		
Value of agricultural by-products	153,36	96	209,92	0	2.6		
Proportion of agricultural sales compared to total agricultural production	0,02	0	0,09	0	1		
Ratio: Value of production devoted to making agricultural by-products / Total value of agricultural production	0,12	0,07	0,14	0	1		
Ratio: Value of main crop / Total value of agricultural production	0,61	0,58	0,20	0	1		
Livestock-raising household	0,83	1	0,38	0	1	83%	17%
Permanent agricultural activity	0,90	1	0,29	0	1	90%	10%
Informant: head of household or spouse	0,78	1	0,41	0	1	78%	22%
Informant is mobile phone user	0,74	1	0,44	0	1	74%	26%
Informant is head of household or spouse and uses mobile phone	0,56	1	0,50	0	1	56%	44%
Dummy - used mobile phone to obtain information about agricultural crops	0,07	0	0,25	0	1	7%	93%
Dummy - used mobile phone to obtain information about by-products	0,01	0	0,11	0	1	1%	99%
Length of mobile phone use if informant is head of household or spouse	9,33	4	14,93	0	132		
Used mobile phone to communicate with clients and suppliers (dummy)	0,35	0	0,48	0	1	35%	65%
Dummy: Perception of improvement in communication (=1 if communication is perceived to have improved a little or greatly)	0,05	0	0,21	0	1	5%	95%
Market (Asillo = 1)	0,48	0	0,50	0	1	48%	52%

Table A. 2.2. Agricultural profit. Total households if the informant is user and head of the household or spouse: N = 429

Variable	*Average*	*Median*	*SD*	*Min*	*Max*	*% Yes*	*% No*
Agricultural profit	2.059,52	958	3.010,31	-819	18.1		
Number of people per household	3,97	4	1,56	1	11		
Proportion of adults in household	0,62	0,60	0,25	0	1		
Highest level of education reached by a member of household	10,85	12	3,26	1	16		
Highest level of education reached by a member of household (if person is informant)	5,38	3	5,78	0	16		
Number of plots	4,69	4	2,03	0	12		
Average plot size	0,57	0,41	0,55	0	3,75		
Number of crops	3,59	4	1,63	1	9		
Value of fodder production per hectare tilled (includes own and rented)	678,27	150	1.170,32	0	7.045,46		
Value of agricultural sales	66,79	0	517,41	0	10		
Total value of agricultural production	2.176,50	1.038,50	3.077,11	0	18.25		
Value of production devoted to making agricultural by-products	127,82	80	161,57	0	1.6		
Value of main crop	1.275,89	550	1.903,90	0	11		
Value of agricultural by-products	156,90	96	232,77	0	2.6		
Proportion of agricultural sales compared to total agricultural production	0,02	0	0,10	0	1		
Ratio: Value of production devoted to making agricultural by-products / Total value of agricultural production	0,12	0,07	0,14	0	1		
Ratio: Value of main crop / Total value of agricultural production	0,61	0,59	0,20	0	1		
Ratio: Value of fodder crops / Total value of agricultural production	0,42	0,42	0,35	0	1,50		
Livestock household	0,83	1	0,38	0	1	83%	17%
Permanent agricultural activity	0,90	1	0,30	0	1	90%	10%
Dummy - used mobile phone to obtain information about agricultural crops	0,08	0	0,27	0	1	8%	92%
Dummy - used mobile phone to obtain information about by-products	0,02	0	0,14	0	1	2%	98%
Length of mobile phone use if informant is head of household or spouse	16,68	12	16,61	1	132		
Length of mobile phone use if informant is head of household or spouse (under 1 year)	0,28	0	0,45	0	1	28%	72%
Length of mobile phone use if informant is head of household or spouse (12 to 24 months)	0,60	1	0,49	0	1	60%	40%
Length of mobile phone use if informant is head of household or spouse (25 months or more)	0,12	0	0,33	0	1	12%	88%
Used mobile phone to communicate with clients and suppliers (dummy)	0,14	0	0,34	0	1	14%	86%
Dummy: Perception of improvement in communication (=1 if communication is perceived to have improved a little or greatly)	0,07	0	0,26	0	1	7%	93%
Market (Asillo = 1)	0,56	1	0,50	0	1	56%	44%

Table A. 2.3. Livestock profit. Total households permanently dedicated to livestock production: N = 704

Variable	*Average*	*Median*	*SD*	*Min*	*Max*	*% Yes*	*% No*
Livestock profit	2.408,54	1.678	2.878,73	-2.28	31.18		
Number of household members	4,23	4	1,85	1	11		
Proportion of adults in household	0,64	0,67	0,26	0	1		
Highest level of education reached by a member of household	10,34	12	3,63	1	17		
Number of species	2,41	2	0,93	1	6		
Average plot size	0,67	0,42	1,11	0	15,5		
Number of head of main animal	11,37	2	189,48	0	5		
Total value of livestock production per species	1.583,75	995	2.432,56	0	32		
Total value of livestock by-products	1.042,95	600	1.401,97	0	11.94		
Total added value of livestock production	2.626,71	1.797,50	3.092,70	0	32		
Sales value of main species	1.516,03	800	3.578,66	0	68		
Sales value of main by-product	587,10	0	1.035,47	0	8.56		
Value of fodder production per hectare tilled (includes own and rented)	917,34	203,98	1.496,66	0	15.740,74		
Ratio: Total value of production per species / Total added value of livestock production	0,57	0,62	0,35	0	1		
Ratio: Total value of livestock by-products / Total added value of livestock production	0,39	0,34	0,34	0	1		
Ratio: Sale value of main species / Total value of livestock production per species	0,78	0,74	1,08	0	16,54		
Ratio: Sales value of main by-product / total value of livestock by-products	0,41	0	0,43	0	1		
Agricultural household	0,97	1	0,18	0	1	97%	3%
Permanent livestock activity	0,98	1	0,15	0	1	98%	2%
Informant is head of household or spouse	0,78	1	0,41	0	1	78%	22%
Informant is user of mobile phone	0,73	1	0,44	0	1	73%	27%
Informant head of household or spouse is mobile phone user	0,56	1	0,50	0	1	56%	44%
Dummy: used mobile phone to obtain information about livestock production	0,05	0	0,22	0	1	5%	95%
Dummy: used mobile phone to obtain information about livestock by-products	0,03	0	0,16	0	1	3%	97%
Length of mobile phone use if informant is head of household or spouse	9,23	4	14,16	0	120		
Used mobile phone to communicate with clients and suppliers (dummy)	0,35	0	0,48	0	1	35%	65%
Dummy: perception of improvement in communication (=1 communication improved a little or a lot)	0,04	0	0,21	0	1	4%	96%
Market (Asillo = 1)	0,46	0	0,50	0	1	46%	54%

Table A. 2.4 Livestock profit. Total households if informant is head of the household or spouse: N = 517

Variable	*Average*	*Median*	*SD*	*Min*	*Max*	*% Yes*	*% No*
Livestock profit	2.690,20	1.83	3.178,76	-1.433	31.18		
Number of household members	4,35	4	1,73	1	11		
Proportion of adults in household	0,65	0,67	0,24	0	1		
Highest level of education reached by a member of household	11,12	12	3,11	1	17		
Number of species	2,41	2	0,96	1	6		
Average plot size	0,72	0,48	1,21	0	15,5		
Number of head of main animal	14,35	2	221,01	0	5		
Total value of livestock production per species	1.791,27	1.09	2.746,24	0	32		
Total value of livestock by-products	1.157,63	746	1.492,06	0	11.94		
Total added value of livestock production	2.948,91	1.948	3.425,36	0	32		
Sales value of main species	1.729,85	900	4.104,89	0	68		
Sales value of main by-product	649,86	45	1.100,97	0	8.56		
Value of fodder production per hectare tilled (includes own and rented)	793,96	182,93	1.257,89	0	7.045,46		
Ratio: Total value of production per species / Total added value of livestock production	0,57	0,61	0,34	0	1		
Ratio: Total value of livestock by-products / Total added value of livestock production	0,41	0,37	0,33	0	1		
Ratio: Sale value of main species / Total value of livestock production per species	0,80	0,73	1,19	0	16,54		
Ratio: Sales value of main by-product / total value of livestock by-products	0,43	0,43	0,43	0	1		
Agricultural household	0,96	1	0,19	0	1	96%	4%
Permanent livestock activity	0,98	1	0,14	0	1	98%	2%
Informant is head of household or spouse	0,76	1	0,43	0	1	76%	24%
Informant head of household or spouse is mobile phone user	0,76	1	0,43	0	1	76%	24%
Dummy: used mobile phone to obtain information about livestock production	0,07	0	0,25	0	1	7%	93%
Dummy: used mobile phone to obtain information about livestock by-products	0,03	0	0,18	0	1	3%	97%
Length of mobile phone use if informant is head of household or spouse	12,56	12	15,20	0	120		
Used mobile phone to communicate with clients and suppliers (dummy)	0,12	0	0,33	0	1	12%	88%
Dummy: perception of improvement in communication (=1 communication improved a little or a lot)	0,06	0	0,24	0	1	6%	94%
Market (Asillo = 1)	0,54	1	0,50	0	1	54%	46%

Table A.2.5. Livestock profit.
Total households if informant is mobile user and is head of household or spouse: N = 394

Variable	*Average*	*Median*	*SD*	*Min*	*Max*	*% Yes*	*% No*
Livestock profit	2.569,19	1.724,30	3.152,77	-1.41	31.18		
Number of household members	4,04	4	1,63	1	11		
Proportion of adults in household	0,62	0,60	0,25	0	1		
Highest level of education reached by a member of household	10,76	12	3,27	1	16		
Number of species	2,37	2	0,94	1	6		
Average plot size	0,70	0,45	1,10	0	12		
Number of head of main animal	16,34	2	251,88	0	5		
Total value of livestock production per species	1.699,18	955	2.853,39	0	32		
Total value of livestock by-products	1.135,89	686	1.471,60	0	11.94		
Total added value of livestock production	2.835,07	1.876,50	3.432,13	0	32		
Sales value of main species	1.726,44	800	4.584,33	0	68		
Sales value of main by-product	651,05	37,50	1.085,99	0	8.56		
Value of fodder production per hectare tilled (includes own and rented)	749,84	180	1.228,41	0	7.045,46		
Ratio: Total value of production per species / Total added value of livestock production	0,55	0,60	0,35	0	1		
Ratio: Total value of livestock by-products / Total added value of livestock production	0,43	0,38	0,34	0	1		
Ratio: Sale value of main species / Total value of livestock production per species	0,81	0,73	1,33	0	16,54		
Ratio: Sales value of main by-product / total value of livestock by-products	0,43	0,42	0,43	0	1		
Agricultural household	0,96	1	0,18	0	1	96%	4%
Permanent livestock activity	0,98	1	0,15	0	1	98%	2%
Used mobile phone to obtain livestock production information (dummy)	0,07	0	0,25	0	1	7%	93%
Used mobile phone to obtain livestock by-products information (dummy)	0,04	0	0,19	0	1	4%	96%
Length of mobile phone use	16,48	12	15,44	0	1		
Used mobile phone to communicate with clients and suppliers (dummy)	0,14	0	0,34	0	1	14%	86%
Dummy: perception of improvement in communication (=1 communication improved a little or a lot)	0,07	0	0,25	0	1	7%	93%
Market (Asillo = 1)	0,55	1	0,50	0	1	55%	45%

References

Aker, J. (2008): Does digital divide or provide? The impact of cell phones on grain markets in Niger. Berkeley: University of California. http://are.berkeley.edu/~aker/cell.pdf (20/04/09).

Barrantes, R. (2008): Comunicaciones Móviles y Desarrollo Socioeconómico en América Latina. Módulo II: Proceso social de Desarrollo. Estudio de caso 2: La telefonía móvil en el ámbito rural. Partial report.

Barrantes, R., Agüero A., Fernández-Ardèvol, M. (2009): La telefonía móvil en el ámbito rural. Estudio de caso de los hogares de Puno-Perú. Mobile Communications and Socioeconomic Development in Latin America Project. Final report. Unpublished manuscript.

De Silva, H., Zainudeen, A. (2007): Teleuse on a Shoestring: Poverty reduction through telecom access at the 'Bottom of the Pyramid. Paper prepared for Centre for Poverty Analysis Annual Symposium on Poverty Research in Sri Lanka. http://www.lirneasia.net/wp-content/uploads/2007/04/lirneasia_teleuse_cepa_-mar07_v30.pdf (13/01/09).

Donner, J. (2006): The Use of Mobile Phones By Microentrepreneurs in Kigali, Rwanda. *Information Technologies and International Development*, 3 (2) – Winter.

Donner, J. (2008): Research Approaches to Mobile Use in the Developing World: A Review of the Literature. *The Information Society*, 24, 140–159.

Esselaarc S., Stork, C., Ndiwalana, A., Deen-Swarray, M. (2007): ICT Usage and its impact on profitability of SMEs in 13 African Countries. *Information Technologies and International Development*, 4 (1): 87–100.

Feres, J., Mancero, X. (2001): El método de las necesidades básicas insatisfechas (NBI) y sus aplicaciones en América Latina. *Estudios y perspectivas*. ECLAC – United Nations. http://eclac.cl/deype/mecovi/docs/TALLER5/8.pdf.(15/10/08).

Figueroa, A. (1983): *La economía campesina de la sierra del Perú*. Lima: Pontificia Universidad Católica del Perú.

Galperin, H., Mariscal, J. (2007): Oportunidades Móviles: Pobreza y acceso telefónico en Latino América y el Caribe. Regional report. http://www.dirsi.net/files/regional/REGIONAL_FINAL_spanish.pdf (10/11/08).

Jagun A., Heeks, R., Whalley, J. (2007): Mobile Telephony and Developing Country Micro-Enterprise: A Nigerian Case Study. Working Paper Series No. 29. Institute for Development Policy and Management. http://www.sed.manchester.ac.uk/idpm/research/publications/wp/di/documents/di_wp29.pdf (27/04/09).

Jensen, R. (2007): The Digital Provide: Information (technology), market performance and welfare in the South Indian fisheries sector. *The Quarterly Journal of Economics*, 122 (3): 879-924.

Parodi, A. (1995): *El lago Titicaca: sus características físicas y sus riquezas naturales, arqueológicas y arquitectónicas*. Arequipa: Regentus.

Souter D., Scott, N., Garforth C., Jain R., Mascarenhas O., McKemey K. (2005): The economic impact of telecommunications on rural livelihoods and poverty reduction: a study of rural communities in India (Gujarat), Mozambique and Tanzania. Commonwealth Telecommunications Organisation for UK Department for International Development. http://iimahd.ernet.in/ctps/pdf/The%20Economic%20Impact%20of%20Telecommunication%20on%20Rural%20Livelihoods-Teleafrica%20Report.pdf. (08/05/08).