ASSESSING THE NEED AND POTENTIAL OF COMMUNITY NETWORKING FOR DEVELOPING COUNTRIES: A CASE STUDY FROM INDIA*

Christopher Blattman
Harvard University

Robert Jensen
Harvard University

Raul Roman
Cornell University

February, 2002

* We would like to thank Dr. Jayaraman and the Center for Entrepreneurship and Development and M.P. Vasimalai and Sinivasan and the DHAN foundation for their collaboration in this project, and Eduardo Acuna, Elizabeth Alexander, Prem Anand, Michael Best, Royal D. Colle, Ashok Jhunjhunwalla, Colin Maclay, Aswin Punathambekar, Blandine Ripert, Myriam Rubalcava, Jayant Sinha and Joseph Thomas for useful comments and discussions. Sarah Marie Poage provided excellent research assistance for this paper. We also thank ICICI for financial support.

I. INTRODUCTION

There has been a great deal of interest in the potential benefits community networking may offer the developing world. This is particularly true of rural information and communication technology (ICT) projects that seek to bring emerging technologies like low cost computing and Internet access to rural households, social institutions and governments. Yet despite extensive activity in this area, our collective understanding of the need for community networking and its ideal form is comparatively weak. Furthermore, there is no 'one-size fits all' design for rural ICT networks; communities vary greatly in their social, economic, and political organization, and therefore information needs, and the design of the most appropriate and relevant community networking system, will vary from place to place and over time within a given area. For successful community networking, the design and implementation of projects should be driven by the specific needs of communities.

What is needed to confront these challenges (the need for planning and evaluation research, and contextually appropriate and community-oriented applications) is a set of methods and tools that can be used to assess the community networking and information needs of specific communities and thereby influence the design of ICT projects. This paper describes a strategy that uses a range of both qualitative and quantitative research methodologies to undertake such an assessment, and provides a specific case study of an ICT project in rural Tamil Nadu, a state in southern India. The study gathered data on the following topics: socio-economic status, agricultural marketing & price search, availability of information on agricultural problems, employment availability and search, media use, household spending, and use and satisfaction with government services. We use these data to construct an 'information and communications profile' that depicts current ICT and media usage and existing sources of information for various community agents (farmers and producers, laborers, government, etc.). We also analyze the methods and costs at which agents obtain information, as well as gaps and information needs. These analyses allow us to demonstrate opportunities for community and economic development through improved information access, and identify critical issues that should be considered in the design of ICT projects. This methodology, and the results obtained, will be greatly valuable to both researchers and academics in their community networking undertakings.

The remainder of this paper proceeds as follows: in the next section, we provide a brief description of the project setting. Section III briefly summarizes the research methods. Section IV describes the economic and social conditions of the region under study, while Section V provides an analysis of the information, communication and media profile of the study area, including a discussion of the implications for project design. We also focus specifically on the needs of agriculture and farmers, since agriculture dominates the social and economic organization of this study region. Finally, Section VI

concludes with a discussion on opportunities for ICT in rural development, including suggestions for future research.

II. THE PROJECT SETTING

The research presented in this article is part of a rural ICT initiative, the Sustainable Access in Rural India (SARI) project.[1] SARI encourages communication and information flows in rural areas with the aim of promoting local welfare and development, and has set out to demonstrate the existence of financially self-sustaining markets for ICT services even among the rural poor. In its pilot phase, SARI is deploying computer and Internet kiosks in up to 100 villages, kiosks that are being developed with the assistance of local entrepreneurs and the DHAN Foundation, a regional non-governmental organization that assists the poor in micro-credit and water management.

Deployment of kiosks, as well as research activities to date, has been concentrated in Melur Block, a small region in the center of the state of Tamil Nadu, India. Figure 1 shows a map Tamil Nadu with district boundaries.[2] In the northeastern part of the District of Madurai (pictured in Figure 2) lies Melur town – a small, crowded community of about 50,000 townspeople that serves as a market center for the approximately 200,000 residents of Melur Block. Here the principal agricultural products of the region – paddy, cotton, groundnut and mango – are bought and sold. Melur town and, more importantly, the villages in its environs, will be described in Section IV.

III. RESEARCH METHODS

The research team, consisting of the authors in conjunction with the DHAN Foundation and the Center for Entrepreneur Development at Madurai Kamaraj University, employed a multi-disciplinary, multi-instrument approach, designed primarily for two purposes: (i) to explore local information needs in depth and to establish a baseline of living standards, information access and media use; and (ii) to promote community participation in and awareness of the project. Three principal research methods were used: field interviews, focus groups, and a household survey questionnaire.

Field interviews assisted in developing a qualitative assessment of local agriculture, market, employment, government, culture, media use, and information needs and availability. Over a three-month period (June to August, 2001), the research team conducted field interviews with farmers, laborers, educators, students, agricultural brokers and vendors, government officials, health workers and non-

[1] The project is part of the Digital Nations consortium of the MIT Media Lab and Harvard's Center for International Development, in collaboration with IIT-Madras and the I-Gyan Foundation. Additional information on the project can be found at http://edevelopment.media.mit.edu/SARI/mainsari.html.

[2] The copyright and all intellectual property rights for these maps belong to Mapience India Limited. No part of these maps may be reproduced, nor may they be disseminated in any form without prior written permission. These and other Mapience maps, as well as their full copyright statement, can be found at http://www.mapsofindia.com

governmental organizations. Additionally, local facilitators with experience in participatory research conducted a dozen focus group sessions, involving groups of men and women, farmers and laborers. Venn diagramming, social mapping, and trend analysis were among the tools employed to help the researchers understand the information needs and uses in the community. Both the interviews and focus group data were used to guide the design of the survey instrument.

The household survey questionnaire consisted of over 500 closed-ended questions on the following topics: household characteristics (including members living outside the home); household assets and expenditures; agricultural activities, inputs, problems, prices and price search activity; employment and employments search activities; household remittances; telecommunications and media use and expenditures; and, government interactions, satisfaction and services used.[3] In addition, short surveys of community characteristics (size, public facilities, available media, and so forth) were conducted in each hamlet twice, often first with the village leader, and once again with a small group of villagers.

The sample of households for the survey was selected in two stages. In the first stage, village administrative areas, or *panchayat*, were selected. The panchayat were chosen to provide a broad cross-section that characterized the region surrounding Melur, but with attention to achieving a mixture of villages that varied in size, distance from Melur, caste composition, current access to telecommunications facilities, and agricultural and non-agricultural activities. In the second stage, within each panchayat households were chosen through a random sampling procedure based on registration lists. Overall, 614 households were surveyed, representing about 10% of the population of the selected villages, and approximately 1.5% of the population of Melur Block.[4] Sample characteristics are provided in table 1.

IV. REGIONAL PROFILE

Before turning to the more detailed survey results, we first provide a broad, qualitative description of the region. Melur Block is subdivided into 63 panchayats.[5] The 1 to 10 villages that comprise the panchayat vary greatly in size, from a handful to a few thousand families. Medium to large settlements have temporary markets, temples, tailors, small shops and sometimes a public telephone. Transport is good in this region as most villages have regular bus service to Melur, and the government has recently repaved many of the roads. Electricity is also common, with about two-thirds of all households reporting its use.

Regarding economic activity, outside of Melur town most households are engaged in agriculture, either as small land-holding farmers, or as landless agricultural laborers. Paddy (harvested to become rice) is the primary crop in this region, though there is some sugar cane, cotton, groundnut and mango. In

[3] The full survey and additional notes are available from the authors upon request.
[4] 40 surveys were discarded due to non-sampling error in the administration of the questionnaire or in data entry.

the villages we analyze, about half of all households own land, though the average landholding was between one and two acres, which according to the local Agriculture Extension Office is only enough to produce 2500 kg of paddy per year. This harvest can be expected to bring a net return of 6,000 rupees (US$122 dollars).[6] Poorer households may own a fraction of an acre and consume their own produce.

Daily agricultural wages are about 50 rupees (Rs) for men (about one US dollar per day) and 25 Rs for women. However, interviews with workers reveal an extremely high rate of unemployment and underemployment. Most laborers work three to four days a week during the wet season, and less or none during the dry season. There is some additional, albeit limited, employment in construction, quarrying, or crafts such as mat or basket weaving. Larger villages may have small industries such as candle or glue-making workshops.

Accordingly, most households in this region are quite poor. Computed from our survey data, average income in this region is about 24,700 Rs (approximately US$500) per year.[7] While more than 95 percent of households own their homes, houses are austere, usually with fewer than three rooms, no access to running water, with stone and plaster walls, mud and dung floors, and thatch roofs. Despite this privation, however, no family interviewed perceived starvation or extreme deprivation as an imminent risk.

Inequality is salient and takes many forms. Most obvious are the divisions along religious and caste lines. Muslim and the few Forward Caste families are by far the most affluent, living apart from the rest of the village and in possession of the largest and best-kept homes. About 90% of families, however, are Hindus of lower caste (Scheduled, Most Backward or Backward). Caste distinctions are strictly observed, and social custom dictates substantially different treatment and mobility among groups. Low caste households, especially Scheduled Castes, typically live in separate parts of the village and are often served by separate shops and tea stalls. If served by the same stall, lower caste customers are given different cups and required to sit on the ground well away from other patrons (and away from the television). The potential for similar exclusion from telephones and computer kiosks is present. Perhaps more importantly, wealth and schooling differ by caste. Table 2 illustrates the disadvantage that Scheduled Caste households face in education and land ownership. Somewhat surprisingly, our estimates of combined remittance, labor and agricultural income appear similar across caste lines, but there is reason to believe that these income figures are overstated for Scheduled Caste households.[8]

---

[5] Between 1 and 10 villages and smaller hamlets typically compose a panchayat.

[6] The same office estimates that approximately 20% of each year's crop is lost to plant disease or pests.

[7] Income was estimated from data on remittances received from family/workers working outside of the village, agricultural yields, and labor earnings. The standard deviation is 35,780 Rs and the median is 14,560 Rs.

[8] In comparing income levels across caste lines, at least three caveats must be considered: (i) variability in income among the SC was high and possibly overestimated (due mostly to remittances from abroad), such that median income was only 12,480 Rs; (ii) only remittances and agricultural and labor income are imputed, not other sources of income; and (iii) labor income may be overstated by an inflation of the number of days worked per year.

Inequality is not limited to caste. For example, while average education in the sample is 4.3 years, tables 3 and 4 illustrate that there are notable differences by gender and age. Younger generations have substantially higher levels of literacy and education than their elders, and men have significantly more education than women. In Sections IV and V we will return to these indicators of inequality when we discuss their relationship with communication and media, and their importance in the design of strategies for a telecenter project. The data show that low caste, education or income constitute a substantial impediment in access, use and affordability of media and communication.

V. INFORMATION AND COMMUNICATIONS PROFILE

A. Media and Communication Ownership, Usage and Expenditures

Turning to the survey results, approximately two-thirds of the households in the sample have electricity, while almost 40% own a radio, 32% own a television set (about half of which have cable TV), and 4% have a telephone. While the proportion of phone and radio ownership was consistent across villages of difference size, none of the phone owners were of Scheduled Caste. Only two of the eight panchayat surveyed possessed a public phone, while public calling booths flourish in Melur town, which is 20 minutes by bus for most households. Television and electricity access is much lower in smaller villages, and those villages farther from Melur. Where private facilities are not available, public ones are sometimes shared. Televisions are common, especially in teashops and village community centers.

Survey respondents were asked to detail their personal communication habits and expenditures. These data will be discussed with the aid of tables and regression analysis. Table 5 provides expenditure and income data for comparative purposes. Overall, total media and communication expenditures are a significant portion of the average household budget. Among all households, total ICT expenditures are 3% of average income, or 8% of household rice expenditures (the latter is a good metric against which to measure the comparative size of media and communications expenditures, since in most households, rice expenditure accounts for nearly one-half of all expenditures). Among ICT consumers (i.e., those households reporting positive expenditures), expenditures were approximately 16% of labor and agricultural income, or 31% of rice expenditures. Thus, ICT expenditures are comparatively large in this region.

In the next subsections, we analyze the various forms of media and communication use in disaggregated form in more detail. In doing so, we will use multivariate regression analysis, which allows us to examine the impacts of specific variables on usage and expenditures, while holding other factors constant. First, we regress media and communications *usage* and *ownership* on several individual and community characteristics using a binary choice (probit) model. The dependent variable (for instance, "Make Phone Calls") is a binary variable, 1 for yes and 0 for no. The coefficients on the independent

variables can therefore be interpreted as the change in likelihood of making a phone call associated with a one unit change in the independent variable. We also regress media and communications *expenditures* on similar individual and community variables using a tobit model (convenient when many of the dependent variable values are zero). Unless otherwise noted, all coefficients can be interpreted as the percentage change in expenditures associated with a one-unit change in the independent variable. The results from those regressions are presented in tables 6 and 7, and will be discussed further below.

1. Telephone & Post

Telephone and mail usage frequency are shown in table 8. Usage of these communication channels is not wide, especially compared to the use of mass media. About 60% of households reported having never used the mail system. The proportion is surprisingly consistent across caste groupings, though not across village-types. Smaller, more remote villages use the mail system less frequently. Meanwhile, just one third of respondents reported making and receiving telephone calls.

The regressions in tables 6 and 7 shed light on what household and village characteristics influence the use of and expenditures on these communications modes. In general, literacy, occupation, distant family members, phone ownership and the presence of a post office are the most influential variables. Referring first to the mail, in the first column of table 6, we see that holding all else constant, households with literate heads of household are 15 percent more likely to send mail, and farming households are 16 percent more likely.[9] Having a household member outside the village increases the likelihood of mail use by 27 percent, while ownership of a phone increases the likelihood by 22 percent. Since phone ownership was reserved for only the wealthiest households, this variable might be viewed as a proxy for large wealth or business dealings, or more simply it may be interpreted as suggesting that people who communicate in one fashion are more likely to communicate in general. Surprisingly, income does not appear to be an important determinant of whether a household sends mail (it is statistically significant but extremely small in magnitude). From table 7 however, we can see that income is a strong determinant of the *magnitude* of expenditures. A 1% increase in income is associated with a .81% increase in expenditures for sending mail (in other words, a 1% increase in income increases post expenditures by .81% of *current post expenditures* (not that phone expenditures increase .87 rupees for every one rupee increase in income)).

The results for the telephone are similar, but have three crucial differences. First, expenditure is more responsive to income than we observed for mail; a 1% increase in income is associated with a 1.11% rise in phone expenditures. Note however that for both post and telephone, expenditures increase almost

proportionately (1 percent for 1 percent) with income. Overall, this suggests that communications expenditures expands in direct proportion to income, which reveals the importance of such communication for even poor, rural households. Second, while the effects on usage of literacy (+21%) and family members away (+17%) are still strong, caste is now also a moderate determinant of phone usage (+7%) and expenditures. Since we control for income, education, village size and occupation, this suggests some independent effect of caste alone, i.e. there are fixed, structural differences in phone use and expenditure by caste that are not due to obvious correlated characteristics. Third, the distance and village size are striking. Simple comparison above of phone and post usage and expenditures across villages suggests that households in smaller and more distant villages communicate less. Our regressions, however, indicate that size and distance do not influence usage or expenditure (i.e., do not present a barrier to usage). The differences observed in univariate comparisons thus reflect differences in education, caste and other individual factors correlated with distance and size, and not distance and size themselves. One might argue, of course, that smaller and more distant villages might have poor educational and communication infrastructure, which is why education and post offices are significant. However, almost all of the villages in the region were located within a kilometer or two of the head panchayat village where the needed facilities can be found. Therefore, who lives in these villages seems to be more important than where those villages are as determinants of phone use and expenditure.

The scarcity of public phones in these areas raises the question of where households make phone calls. Our survey results indicate that more than half of people making calls do so from shops or private sector phone kiosks, often in Melur or another large village in the region. A third make calls from their own home or the homes of friends and family. Of those who receive calls, however, most often do so at their own homes or homes of friends and family.

Finally, and perhaps more important than access, is what the villagers use communications for. Tables 8 and 9 describe the uses of media and communications. In the eight panchayat examined, more than eighty percent of responses listed "communicating with friends and family" as their primary reason for using a phone or the mail. "Requesting money," usually from family afar, comprised the bulk of the remaining responses. In the villages where work is often unavailable and always poorly paid, many families have sent sons, husbands and daughters away to find work, especially in East Asia and the Middle East. These migrants, when they find work, typically send large amounts of earnings home. Roughly one quarter of the households have a household member living away for work or school, and a sixth of the households we surveyed reported receiving remittances from family members living outside

[9] Running the same regression with a variable of years of education yields similar, but less significant results. It may be that the additional education beyond the point of literacy has limited effects on the tendency to use communications and media.

the area. Communication with these household members is frequent, often monthly or even weekly. The median remittance received is about 8,000 Rupees per year, often in monthly or bi-monthly payments. Remittances are often sent by mail, or when arriving from out of country, through a middleman. These remittances represent an important source of income for this area, and the various media of communications are an important part of ensuring their delivery.

"Emergencies" was also a common response to the best use for a phone, and one of the privately owned or government phones was often available for this purpose. Overall, most villagers suggested that the primary benefit of public facilities would be personal uses. Regarding commercial use, farmers were asked to what extent they use telephones to check agricultural prices. Of those who attempted to check market prices before the day of sale, less than 5% did so using a telephone. Nearly all relied on word of mouth, going to the market to check, or a mass media source. This may be evidence of a need for better access to communication. However, as will be discussed below, there are many reasons to believe that phoning for market prices is not of value to farmers in this region. Phone use for checking market prices or job-hunting did not appear prevalent in this area.

2. Mass Media: Television, Radio & Newspaper

By comparison to phone and post, mass media are much more commonly used, often communally, and primarily for news and entertainment. Referring to table 8, we see that almost 60% of the respondents report watching television, half of the respondents listen to the radio, and around 30% read the newspaper. A considerable percentage of the villages use these media in public places. In fact, this communal sharing accounts for the relatively high levels of media usage in comparison to the low levels of actual television and radio ownership and newspaper subscription. Almost 80% of the respondents who read the newspaper report doing so in tea stalls or shops; 30% of the respondents watch TV at places other than their residence; and 60% of the respondents who listen to the radio do so at home.

As for what factors influence media usage the most, in the regressions in tables 6 and 7 many of the same patterns emerge as with phone and mail usage and expenditures. Income does not appear to have an effect on usage of newspapers, TV and radio, but does have a large, positive impact on expenditures on cable TV and newspapers. A 1% increase in income is associated with a 1.26% rise in cable expenditure and a very strong 2.33% rise in expenditures on newspapers. Literacy and being a farmer are again important correlates. Literacy, for instance, is associated with a 35% greater probability of watching TV. These results may be proxies for a number of attributes, one possibility being that greater education and a farming occupation promote a taste, or a need, for information.

The determinants of cable expenditure and television ownership regressions are distinctive in one important way: location now matters. Table 7 shows that smaller village size and greater distance from

Melur are associated with lower cable expenditures. TV ownership also decreases somewhat with distance. One explanation is that cable access is more limited in some of the more remote villages in Melur. Surprisingly, this is not because of expensive cabling. Most cable television programming is accessed by satellite by a local entrepreneur, who then leases connections to other households in the village. More distant and smaller villages may not only have too small a cable market to justify the connection, but also lack entrepreneurs.

Even though the primary use of these media is news and entertainment (see table 9), they have nonetheless demonstrated (albeit anecdotally) an important effect on village society and culture in the region. In focus groups and interviews, many villagers claimed that their awareness of events in the state, nation and world is much greater than before due to these media.

B. The Farmer: An Assessment of Information and Communication Needs

An 'information gap' (that is, an observed disparity between information an individual demands and what is available and affordable in a timely fashion and an appropriate format and quality) was observed in several domains. In particular, such a gap arose in access to government information and services, and educational material. However, one of the most important information gaps found relates to agriculture, which we now focus on in detail since it is such a prominent aspect of the social and economic organization of this region and therefore the most promising area for ICTs to have an impact on communities.

There are two primary types of efficiency that affect agricultural productivity: technical efficiency and allocative efficiency (Hornik, 1988). These concepts may be connected to the quality of information flows. Technical efficiency refers to the application of knowledge to increase productivity (and may be related to access to extension education and other pedagogical and informational sources). Allocative efficiency means the ability of the farmer to manage resources to maximize economic return (which may be linked to information about marketing, credit arrangement, and crop investment).

Government programs and protection already seek to help farmers to improve efficiency through seed experimentation and subsidization, the provision of Agricultural Extension Officers (AEO), and price and market regulation. The question is whether the improvement of the flow of locally relevant information, either publicly or privately provided, can enhance efficiency or promote innovation. Hornik estimates that "the failure of conventional programs to reach their audiences supports the explanation that non-optimum practice reflects a poor flow of information and not an unwillingness of audiences to respond."(Hornik, 1988: 158). There are, however, important caveats. In this section we will discuss opportunities ICTs may provide to enhance agricultural technical and allocative efficiency, as well as potential constraints and limitations.

Information flows and technical efficiency

Three quarters of the farmers in our sample reported agricultural trouble or problems in the past season, the principal problems being plant disease (30% of respondents), pests (20%) and water problems (20%). The local AEO indicated that approximately 20% of a yield is lost to pests and disease each year. The data show, however, that many farmers experience an information deficit with respect to such problems. For example, one quarter of all farmers reported having no source of information at all for pest, plant disease and animal problems.

Where solutions to problems are sought out or available, external sources of information and expertise are rarely used even though survey respondents often rated them as the most valuable. Table 10 illustrates this finding. "Word of mouth" is by far the most common source of information on solutions to agricultural problems, yet it is also the source that is rated lowest in terms of satisfaction with reliability, ease of obtaining a solution, and usefulness. The availability, reliability and usefulness of the information transmitted through word of mouth was evaluated on average at 2.7 in a scale of 4 (where 1 is "very dissatisfied" and 4 is "very satisfied"). Agricultural storeowners and AEO were the next most commonly cited source of information on solving agricultural problems, with a moderate level of satisfaction with the results (2.9 and 3.0 respectively, on the same scale of 4). Storeowners sell pesticides and disease treatments, and after an outbreak many farmers will bring a sample of the afflicted plant to the store and rely on the operator's expertise to suggest a remedy. AEO make periodic visits to villages in the region to offer advice. Yet there are few extension officers for the Block, and most small villages and poor villagers claim they never see or speak to the government representative.

By contrast, only a very small percentage of respondents reported radio and television as principal information sources for solving agricultural problems. However, when they are used, the information provided through these media is rated as the most useful, reliable, and easy to obtain (radio on average rated at 2.9, and television at 3.7). Finally, 25% of the respondents get information about new agricultural products (fertilizers and seeds) through word of mouth, and 25% through the AEO. Roughly 10% have no source at all. Only 15% received this information through radio or television.

Information flows and allocative efficiency

Under the right circumstances, improvements in price and market information can have substantial welfare improving effects. A strong argument for this is laid out by Eggleston, Jensen and Zeckhauser (2001), who assessed the impact of rural ICTs on market integration in rural China. These authors argue that better access to price information not only helps farmers obtain a better price for their crop, but may also help them make better production decisions and enhance market efficiency, improving overall agricultural productivity and potentially lowering consumer prices.

Among our sample, farmers who sold their crop in the market usually did so through a broker or commission agent from Melur town or Madurai city (41%), direct to a store (21%) or in a government regulated farmers' market (16%). Some travel directly to Melur town or Madurai city to sell (42%), while most of the rest sell it to a middleman in their panchayat or block (55%). The reasons most often cited for selling to this person or at this location are: "needing money right away" (49%); "best price available" (20%); "amount to small to sell elsewhere" (9%); and "indebted to buyer" (5%).

Finally, just over half of farmers check market prices before selling their crop. Most have no source of information at all. Those that do cite word of mouth as their primary source of information, followed up with actual trips to the market to check, or inquiries through a middleman or broker. Price checks, however, are infrequent. Very few farmers check prices more than two or three times in a season. Further, these checks occur mostly on or just before the day of sale, and often in only a single market. There are, however, a small percentage of villagers (7%) who report getting market and agriculture information from newspapers, radio, and television.

Price applications have generated a fair amount of excitement amongst many rural ICT projects. Nevertheless, as Hornik points out in regard to market information through community radio, "a program to deliver market price information over the radio assumes that current knowledge is inadequate and farmers can act on new information. Both assumptions demand evidence"(Hornik, 1988: 21). More specifically, to reap the benefits of market integration and price information, several conditions must be met: (1) all players must have timely access to good quality, low-cost information, (2) prices must be free to fluctuate, (3) farmers must be free to sell to whom they please, (4) transport costs must be low, (5) farmers must be able to control their output (i.e., when they harvest or sell), and (6) there must be many buyers and sellers of the product. Eliminating the first of these constraints through ICT will not necessarily improve markets. First, in Melur Block, there is little variability in prices during the main harvest season. The government in this particular region fixes paddy prices for a period of time, and restricts the sale of paddy over state (and in some cases district) lines. Thus farmers have few markets in which to sell their goods. Second, farmers have established relationships with particular brokers, and say that they seldom "price shop". In some cases farmers are obligated to sell to a middleman who lent them money early in the season to buy seed and fertilizers. Third, transport costs are not small relative to the price of the goods, and farmers are not always free to transport crops over state and district borders. Fourth, few farmers can control when they harvest and sell, since drying and storage facilities are rare. Fifth, the varieties of rice produced are large in number and often specific to a particular region and market. Consumers outside this region may have no interest in these varieties, meaning markets are small and, by implication, less efficient. Given the opportunities available, it is perhaps not surprising that

farmers are satisfied with the ease and usefulness of the word of mouth information they receive on market prices.

VI. DISCCUSSION AND IMPLICATIONS FOR DESIGN

The two main objectives of the research effort described in this paper were to gather information to shape the initial implementation of the project and to establish a baseline for evaluative research. In this section we provide suggestions to guide and influence project design based on the data gathered, and also point out directions and concerns for future research, not just for this specific project, but more generally for other practitioners and researchers.

The Fundamental Importance of Basic Communications

First, our research shows that there is a large need (and by extension, market) for basic communication services in the rural areas of this region. ICT are currently used primarily for news, entertainment and communication with family and friends. Rural households, even the poor, are willing to spend significant portions of their income on communication and media. In fact, need and circumstance, not income, seem to be the primary determinants of ICT usage and expenditure. The implications of this demand (and the fact that even poor people are willing to spend) are threefold. One, ICT interventions may start their operations by first focusing on providing basic communication and information services rather than more sophisticated applications. Two, if telecenter services can be provided more cheaply than currently available, then the kiosks can improve standards of living for the poor; less expensive access will directly impact disposable incomes. Three, this demand and the willingness to pay show promise for the economic sustainability of such projects.

The Danger of Exacerbating Existing Inequalities

Unless deliberately designed otherwise, ICT projects may exacerbate the informational divide in the presence of strong social stratification, but in ways that might not have been anticipated. The results of the regression analysis suggest that the effect of village location, once individual and infrastructure characteristics are controlled for, is very small; distance from the nearest city does not matter. Income, however, is strongly associated with greater expenditures. Higher education and caste are also associated with ICT usage and expenditures, and since women are far less educated than men, this suggests a gender gap as well. Each of these sources of inequality has important implications for telecenter design and implementation. First, the positive income-expenditure relationship suggests that low cost services may be more equalizing than strategies aimed at wide coverage – that is, strategies that seek to put kiosks in more villages or remote areas. A cheaper kiosk in the head village rather than in every hamlet may

actually increase physical access, not limit it. Second, the same correlation between income and media expenditure suggests a need for low-cost, affordable technologies in order to avoid economic barriers to access as much as possible. Third, non-discriminatory access to all castes, men and women, will require careful thought over physical placement, design and staffing of the telecenter, as sociocultural differences may hamper the participation of the most disadvantaged villagers. Fourth, given the low rates of literacy in this area, and how literacy varies along other dimensions, it is important that ICT projects that focus more on computer and internet-related services employ technologies for interaction, for example voice recognition, that permit usage by a wider range of persons and do not exacerbate existing inequalities. A final factor worth considering for the design of an ICT intervention is that much of current mass media usage is communal, as revealed in table 8. A much higher fraction of individuals report using television, radio and newspapers than actually report owning or spending on these items. Much of the communal use is in public places such as tea stalls and other shops. As much as possible, to be more integrative and in harmony with existing modes of mass media usage, ICT interventions should build on this model and consider a placement and design of a kiosk that fosters and promotes communal use as a mode of access and use.

Besides these strategic considerations, it is important to emphasize that information is a necessary but not sufficient condition for development. Our data show already existing inequalities in the studied villages: the survey demonstrates social and economic divides that are not necessarily linked to information and communication deficiencies (or, at least, are surely not the product of ICT divides). ICT-enabled projects make sense in the context of an 'integrated rural development' system, where hardware is a means to an end, not an end in itself. In this context, the following priorities arise:

The Provision of Locally Relevant and Contextually Appropriate Services

Information flows for technical efficiency

Our data suggest the opportunity to improve agricultural technical efficiency through ICT kiosks, but do not support investment of resources in methods to enhance allocative efficiency. Presently farmers are significantly more likely to make use of information, and in general have higher levels of ICT ownership and expenditure, than other members of the sample. Despite this greater access to ICT, our analysis suggests that farmers also have information needs that, if met effectively, may have substantial impacts on their well-being and agricultural productivity. There is a demand (and market) for expert advice. Improvements in technical efficiency require information on agricultural pests and diseases, new seeds, and techniques. ICT kioks may provide some of these extension services, and foster existing agricultural diffusion and support networks, especially where agricultural extension has not been given a sufficiently high priority by government.

Fostering the 'innovation effect'

Besides allocative and technical efficiency, Hornik mentions a complementary concept, the 'innovative effect', which is "the ability to decode new information, to evaluate the costs and benefits of alternative information sources, and to establish access to newly available, economically useful information" (Hornik, 1988: 31). The survey data provide a demographic and media use profile that will help guide the content applications and their format in order to activate the farmers' innovative effect. For example, the survey data show that, as a prerequisite for farmers to decode and digest new information, that information will have to be preferably given in the local language, Tamil, and in oral or audiovisual form.

The importance of awareness-raising

Rural ICT-projects are intrinsically concerned with creating demand. Although our survey shows some patterns of farmers' information use and needs, the data reflect a predictable lack of demand for computer-mediated information and communication services, presumably because villagers are unaware of what a ICT projects can offer them, or what such projects are about. There may be an overall absence of expectations (or hope) about probable improvements of information flows from which they can benefit. A community-based communication center or telecenter is a new resource in the community, and therefore it is a demand-creating project. In this respect, Hornik states that "demand problems call first for investment in motivation and in mechanisms (like group meetings and multiple channels) that ease and reinforce participation" (Hornik, 1988: 12). From past experience in development communication projects, it is clear that people most in need of a specific information or communication service may not necessarily respond to simple service availability. This indicates the importance of raising awareness about the accessibility (and potential) services that telecenters may offer. In this sense, the role of village information brokers, such as storeowners, ICT kiosk operators, and even the AEO (as shown by our data), can be instrumental in the spread of awareness about the role and potential of the SARI kiosks in the communities. This is connected to the concept of 'ICT intermediaries' (Colle & Roman, 2001), organizations (or individuals) who own ICTs and who can act as "gatekeepers between cyberspace and the organic, informal information systems of those on the wrong side of the digital divide" (Heeks, 2002: 7).

An integrative multimedia approach

Our data show that the choice of appropriate communication channels should not be reduced to computer and the Internet. The high rate of illiteracy, the popularity of television and radio, and the rich oral tradition of the villagers, underline the opportunities of an integrative multimedia approach, whenever possible. As documented by many years of development communication projects in the developing world, the potential of media such as video and even audiocassetes should not be

underestimated (Fraser & Restrepo-Estrada, 1998). Additionally, this option is enhanced by the increasing possibilities for convergence of Internet with video and radio —as the UNESCO-funded Kothmale radio and Internet project in Sri Lanka (Gumucio, 2001), and the recents experiments with Internet and digital video by the Swaminathan Foundation in Tamil Nadu (Thamizoli P. E., personal communication).

An Agenda for Grassroots-level Research

Today in the emerging 'ICT for development' field, there are many analysts studying economic changes at the macro level —such as growth of the ICT sector, number of computers and users, and GDP, for instance. These economic indicators do not gauge what is happening within communities (how technology being used, if at all, by whom, and for what, and what are the social constraints and opportunities for equitable and effective use). At the micro level, there are several international 'research and development' projects that are testing ICT uses and applications for rural development. There are some efforts underway, and serious awareness about the importance of research (Whyte, 2000; Roman & Blattman, 2002), but to date there are no solid reports about the viability and functions of projects such as rural telecenters (Hudson, 2001). Probably it is too early to assess impact, but, in any case, there is a strong need for grassroots level research efforts, such as the project we have described in this article.

Our survey suggests that farmers suffer information and communication deficits that a proactive telecenter can help alleviate. However, it is evident that we cannot still predict if ICTs will be a sufficient, cost-effective, or appropriate answer to these problems. Similarly, it is also important to point out that this research is not able to anticipate the ways in which farmers, if at all, will appropriate the technology, or how will they harness the opportunity to make the ICTs work for them. These questions remain open and need an answer. The analysis presented here is part of a continuing research effort. There needs to be a continuous monitoring of farmers' adoption of the ICT interventions. The needs of farmers are not static, and changing needs and demands must be monitored in order to feedback into change in ICT interventions.

Our data show that certain kind of information is of great value to farmers, and they spend the energy and money necessary to seek and obtain that information, mostly in informal ways. However, the research questions must go beyond the value of information flows in agriculture productivity. There is a need to document the process by which ICT kiosks are able to improve the quality of that information (in terms of information reliability and trust, ease of availability, and cost for the farmer). There also needs to be more research investigating to what extent farmers (and other community members) are willing to adopt ICT innovations and help maintain the facility with financial and social support (how potential rewards are able to counterbalance possible risks and initial reticence). It is also important to examine the relationship between the investment in the quality of information flows and the tangible benefits farmers get from that

venture. Formative and impact evaluation will show if it is worth the investment and the human effort (private or public, or both).

It is clear that our data collection exercise presupposes the need for locally relevant applications: the emphasis is not on the technology, but on feasible ways to enhance the community's information and communication capacity through the use of ICT (technology as a means, not an end in itself). The survey data presented provides a map of the information and communication uses and patterns of farmers in the selected villages. The most important next steps are translating such research results into realistic opportunities (locally relevant and financially and socially sustainable applications), and rigorously evaluating how those new opportunities facilitated through ICT affect social and economic community development.

REFERENCES

Colle, R.D. and R. Roman: 'Challenges in the Telecenter Movement'. Paper presented at the ICA-IAMCR Conference on the Digital Divide, University of Texas-Austin, November 2001.

Eggleston, K., R. Jensen, and R. Zeckhauser: 'Information and Communication Technologies, Markets and Economic Development'. **?**

Fraser, C., and S. Restrepo-Estrada: *Communicating for Development.* Tauris, London. 1998.

Gumucio, Alfonso: *Making Waves: Stories of Participatory Communication for Social Change.* Rockefeller Foundation, New York. 2001

Heeks, R.: 'i-Development Not e-Development'. *Journal of International Development* 14. 2002: 1-11.

Heeks, R.: 'Information and Communication Technologies, Poverty and Development'. Working Paper Series of the Institute for Development Policy and Management, University of Manchester. 1999 (June). [available online] http://www.man.ac.uk/idpm

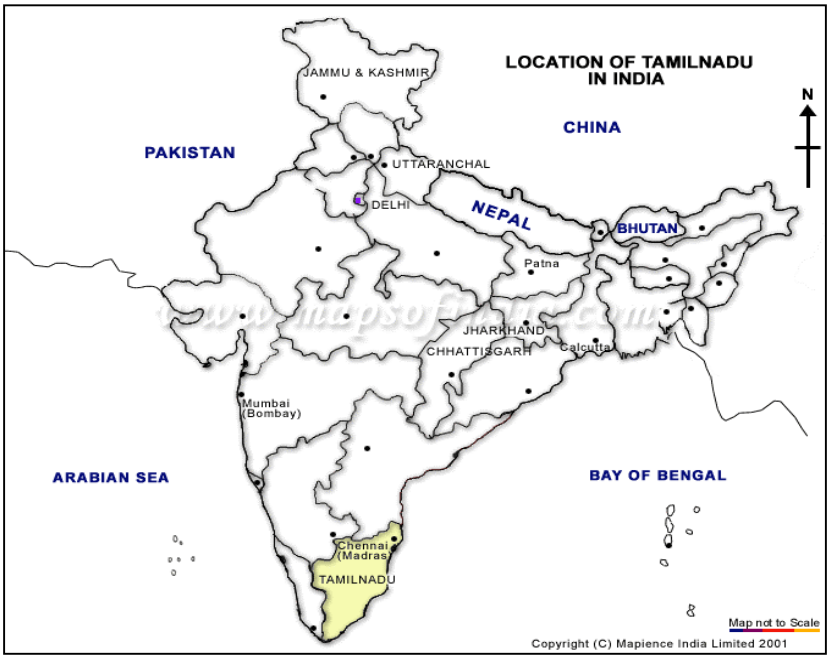
Hornik, R.: *Development Communication: Information, Agriculture, and Nutrition in the Third World.* Longman, New York. 1988.

Hudson, H.: 'Telecenter Evaluation: Issues and Strategies'. In C. Latchem and D. Walker (eds.) *Telecenters: Case Studies and Key Issues*. The Commonwealth of Learning, Vancouver. 2001.

Roman, R. and C. Blattman: 'Research for Telecenter Development: Challenges and Opportunities'. *Journal of Development Communication* [in press]

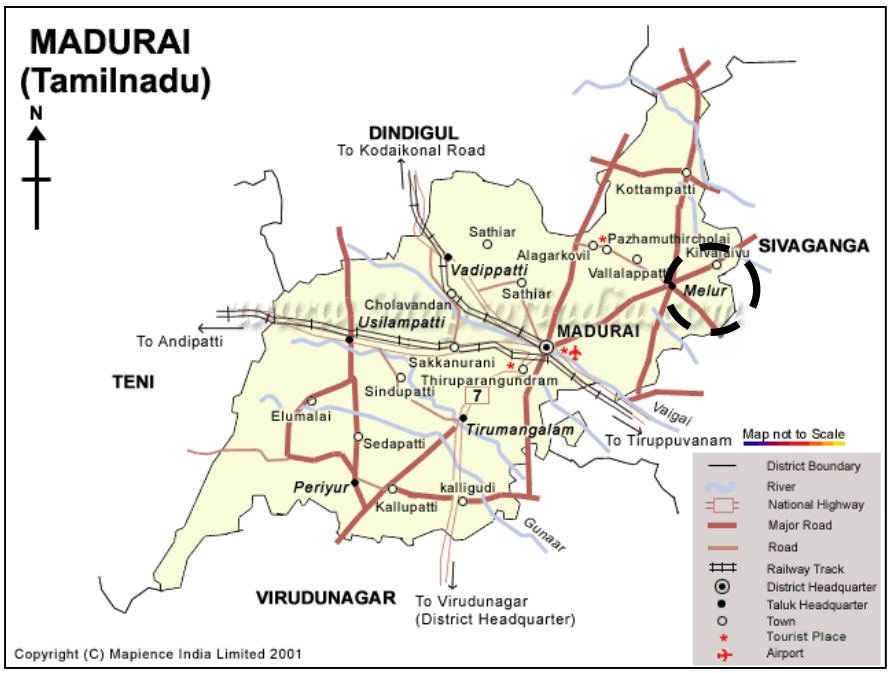
Whyte, A.: *Assessing Community Telecenters: Guidelines for Researchers.* International Development Research Centre, Ottawa. 2000.

Figure 1: Map of India with state of Tamil Nadu highlighted



Reprinted with permission of Mapsofindia.com

Figure 2: Map of Madurai District. Melur is located to the northeast of Madurai city.



Reprinted with permission of Mapsofindia.com

Table 1: Sample Size & Gender Relative to Population

	Sample*	Panchayat Total**	% of Panchayat	Block Total**	% of Block
Village Clusters (Panchayat)	8	8	100.0%	63	12.7%
# of Households	614	4,623	13.3%	49,378	1.2%
# of People	3,263	19,954	16.4%	213,950	1.5%
% Scheduled Caste	15.0%	16.2%		17.4%	
% male	51.0%	49.7%		50.0%	

*654 households were originally surveyed, but 40 had to be dropped due to severe non-sampling errors.

** Total population is based on 1991 census data for Melur Block. 2001 census figures are not yet available, but population growth has been estimated as high as 10-20% for this region.

Table 2: Variation in Income and Education by Religion and Caste***

	Hindu (by Caste)				Muslim
	Scheduled	Most Backward	Backward	Forward	
Sample Size (Households)	96	74	312	3	53
Sample Size (People)	490	361	1678	16	309
Avg Education (Yrs)*	3.4	4.2	4.5	6.6	4.6
% Literate in Tamil**	42%	42%	48%	71%	66%
% Literate in English**	13%	14%	16%	29%	16%
% Farmers	32%	65%	61%	100%	55%
Average Acres Land	1.1	4.4	2.5	2.6	1.1
Average Income					

Table 3: Variation in Education by Age Group

	Age Group				
	6-10	11-20	21-30	31-50	50+
Sample Size (People)	271	726	722	794	384
% Enrolled in School	91%	43%			
Avg Education (Yrs)*		6.9	5.7	3.4	1.9
% Literate in Tamil**		66%	52%	36%	29%
% Literate in English**		24%	18%	9%	3%

Table 4: Variation in Education by Gender

	Female	Male
Sample Size (People)	1,587	1,649
Average Age	27.0	28.6
Avg Education (Yrs)*	3.3	5.2
% Literate in Tamil**	36.6%	57.8%
% Literate in English**	10.3%	18.9%

* Average of highest level of education achieved (in years) amongst household members over 11 years of age.

** Literacy is estimated by the number who reported "fair" or "good" ability in reading the language. This has obvious limitations, but is felt to be a better measure than the census estimate, which simply asks the respondent whether he or she can write their own name.

*** Caste was not reported by 70 households

Table 5: Comparison of Income and Expenditures

	Income (Rs/Year)	Income (Rs/Month)	Income (US$/Month)
Median	14560	1213	24.76
Average	24691	2058	41.99
1 acre paddy	6000	500	10.20

	Median Expense (Rs/Month)	Average Expense (Rs/Month)	Average Expense (US$/Month)	As % of Average Rice Expense	As % of Average Income	As % of Rice Expense (Exp > 0)	As % of Income (Exp > 0)
Rice	643	792	16.15	100%	38%	100%	53%
Other Food	643	753	15.37	95%	37%	100%	53%
Transportation	214	355	7.25	45%	17%	33%	18%
Electricity	25	47	0.95	6%	2%	6%	3%
Post	0	7	0.15	1%	0%	9%	5%
Telephone	0	44	0.89	6%	2%	8%	4%
Cable	0	9	0.19	1%	0%	2%	1%
News	0	4	0.09	1%	0%	12%	7%
All ICT	**0**	**65**	**1.32**	**8%**	**3%**	**31%**	**16%**

Table 6:

Effect of Household and Village Characteristics on the Probability of Media & Communications Usage & Ownership

Coefficient estimate results of probit (probability) regression (Note A)

Heteroskedastic error-corrected z-statistics are in italics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Respondents who report that they...					**Do you own a…**	
Dependent Variable	Send Mail	Make Phone Calls	Read the Newspaper	Watch Television	Listen to the Radio	Telephone?	Television?
Income (000's) (Note B)	0.0014	0.0008	0.0010	0.0013	0.0011	-0.0001	0.0017
	1.71	*1.41*	*1.14*	*1.97*	*1.27*	*-0.49*	*2.35*
Caste Variable (Note C)	-0.01	0.07	-0.03	0.03	0.04	0.02	0.12
	-0.22	*2.50*	*-1.09*	*1.05*	*1.39*	*2.43*	*4.31*
Literacy Dummy (Note D)	0.15	0.21	0.06	0.35	0.04	0.02	0.16
	3.11	*4.62*	*1.27*	*7.58*	*0.88*	*1.86*	*3.41*
Farmer Dummy	0.16	0.15	0.03	0.14	0.25	0.03	0.22
	3.07	*3.21*	*0.68*	*2.83*	*4.97*	*2.62*	*4.58*
Own Phone Dummy	0.22	*(Note F)*					
	1.81						
Family Member Away Dummy	0.27	0.17				0.01	
	4.11	*2.85*				*0.71*	
Own TV Dummy			0.48				
			7.11				
Subscribe to Cable Dummy			0.13				
			1.06				
Village Dummy Variables (Note E)							
Post Office in Village	0.14						
	2.37						
Public Telephone in Village	0.02	-0.06				0.01	
	0.23	*-1.03*				*0.61*	
Population <250	-0.08	-0.09	-0.31	-0.03	-0.20	0.01	-0.13
	-0.74	*-0.88*	*-2.63*	*-0.26*	*-1.92*	*0.50*	*-1.24*
Population 250-999	-0.01	0.11	0.00	0.09	0.02	-0.01	0.06
	-0.10	*1.36*	*-0.06*	*1.13*	*0.28*	*-0.72*	*0.74*
Population 1000-1999	-0.07	0.11	0.02	0.06	0.12	0.01	0.01
	-1.01	*1.55*	*0.37*	*0.95*	*1.78*	*0.71*	*0.09*
10-19 km from Melur	0.04	-0.04	0.09	0.00	0.07	-0.01	-0.30
	0.48	*-0.50*	*1.14*	*0.04*	*1.02*	*-0.83*	*-4.37*
20+ km from Melur	0.06	0.04	0.21	0.01	0.19	0.05	-0.29
	0.55	*0.41*	*2.39*	*0.08*	*1.89*	*1.48*	*-3.65*
Number of observations	476	456	476	476	476	476	476
Pseudo R-squared	0.1077	0.1312	0.2613	0.129	0.0787	0.1722	0.1872
Observed probability	0.41	0.28	0.62	0.36	0.48	0.04	0.34
Predicted probability	0.41	0.25	0.71	0.34	0.48	0.02	0.31

Note A: As this is a probit regression, the coefficients on the independent variables should be interpreted as the change in the probability of the dependent variable associated with a change in the independent variable. For example, in regression (1), a household that has an immediate family member living outside the village has a .23 greater probability of sending mail than a household without a family member away.

Note B: The income variable reported is in thousands of Rupees. The coefficient is the change in probability associated with a 1000 rupee change in income. Also note that this variable is a proxy for household income based on estimated proceeds from paddy and cotton cultivation, agricultural and construction labor, and household remittances. 68 households have no income under this method and were dropped from the sample.

Table 7:

Effect of Household and Village Characteristics on Media & Communications Expenditures (in Log Form)

Coefficient estimate results of tobit analysis (Note A)

t-statistics in italics

	(1)	(2)	(3)	(4)
Dependent Variable	ln (Post Expenditure)	ln (Phone Expenditure)	ln (Cable Expenditure)	ln (Newspaper Expenditure)
ln (Income) (Note B)	0.81	1.11	1.26	2.33
	2.35	*2.66*	*2.29*	*1.81*
Caste Variable (Note C)	-0.20	0.98	2.27	-1.29
	-0.45	*1.85*	*3.01*	*-0.88*
Literacy Dummy (Note D)	2.33	4.28	3.36	6.46
	3.05	*4.65*	*2.73*	*2.31*
Farmer Dummy	3.52	3.59	3.97	0.98
	4.16	*3.56*	*2.87*	*0.35*
Own Phone Dummy	1.40	9.14		
	0.82	*4.99*		
Family Member Away Dummy	4.14	4.25		
	4.42	*3.89*		
Subscribe to Cable Dummy				10.73
				3.24
Village Dummy Variables (Note E)				
Post Office in Village	*1.15*			
	1.25			
Public Telephone in Village	0.56	-2.33		
	0.54	*-1.86*		
Population <250	-1.11	-2.56	-49.97	-61.46
	-0.65	*-1.21*	.	.
Population 250-999	-0.87	0.22	-6.27	3.28
	-0.70	*0.15*	*-2.81*	*0.88*
Population 1000-1999	-1.31	0.22	-1.97	-4.13
	-1.27	*0.18*	*-1.32*	*-1.21*
10-19 km from Melur	1.06	-0.26	-4.29	-0.17
	0.93	*-0.20*	*-2.87*	*-0.05*
20+ km from Melur	2.93	1.25	-2.26	-6.75
	1.73	*0.65*	*-0.74*	*-1.12*
Constant	-13.55	-21.21	-24.62	-44.69
	-3.73	*-4.63*	*-4.06*	*-3.09*
Number of observations	476	476	476	476
Pseudo R-squared	0.0477	0.0864	0.1097	0.1011
Non-zero observations	177	149	80	30

Note A: As the dependent variable is in logarithmic form, the coefficient on our dummy variables should be interpreted as the % change in expenditure associated with a change in the dummy variable from 0 to 1. Interprteation of ln(income) is described in Note B. Also note that this is a tobit regression. A tobit regression accounts for the bias inherent in the fact that many of the observations of the dependent variable, ln(expenditure), are zero. While this leads to better estimation of coefficients, tobit does not allow for the correction of heteroskedastic errors. This is not a serious problem, however, as it in fact suggests that the t-statistics are mildly understated and that the coefficients are slightly more statistically significant than reported.

Note B: Income is recorded in Rupees and id converted to logarithmic form. Thus the interpretation of the coefficient is the % change in expenditure from a 1% change in income (i.e., in regression (1), a 1% increase in income is associated with a 69% increase in post expenditures). Also note that this variable is only a proxy for household income based on estimated proceeds from paddy and cotton cultivation, agricultural and construction labor, and household remittances. 68 households possessed zero income under this method and were dropped from the sample.

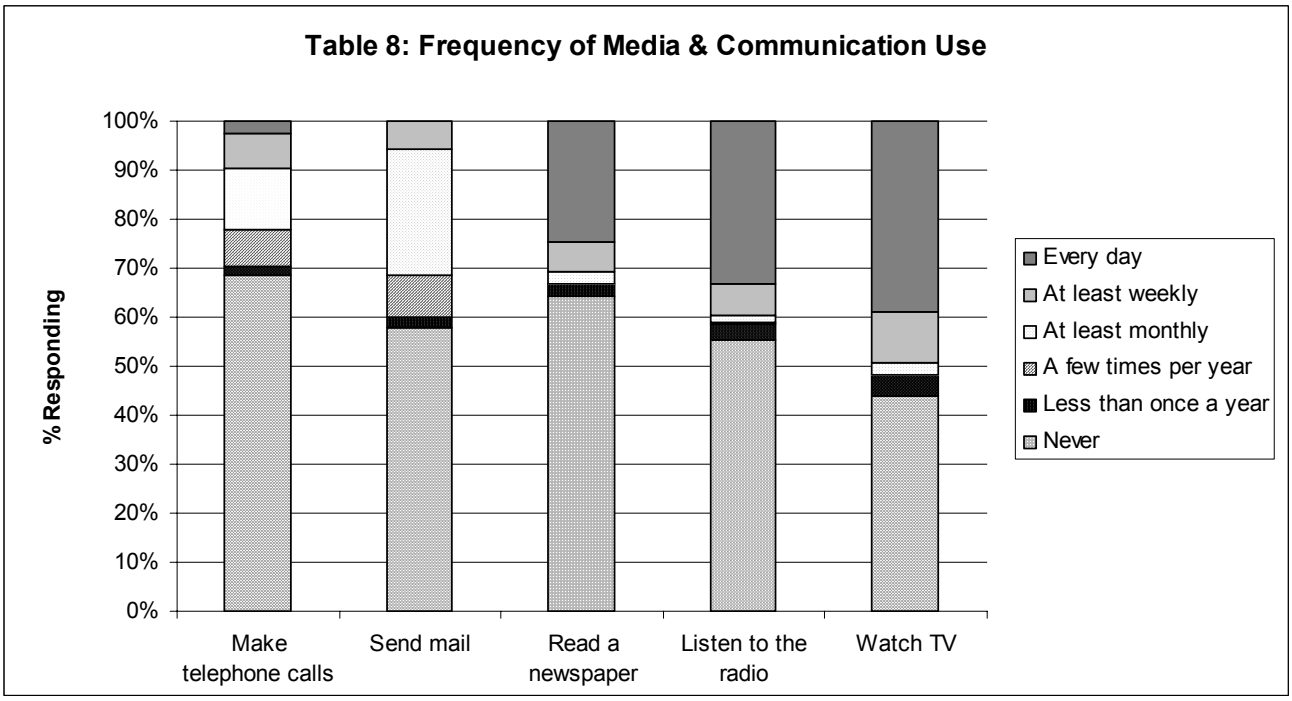


Table 8: Frequency of Media & Communication Use
% Responding
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Make telephone calls
Send mail
Read a newspaper
Listen to the radio
Watch TV
Every day
At least weekly
At least monthly
A few times per year
Less than once a year
Never

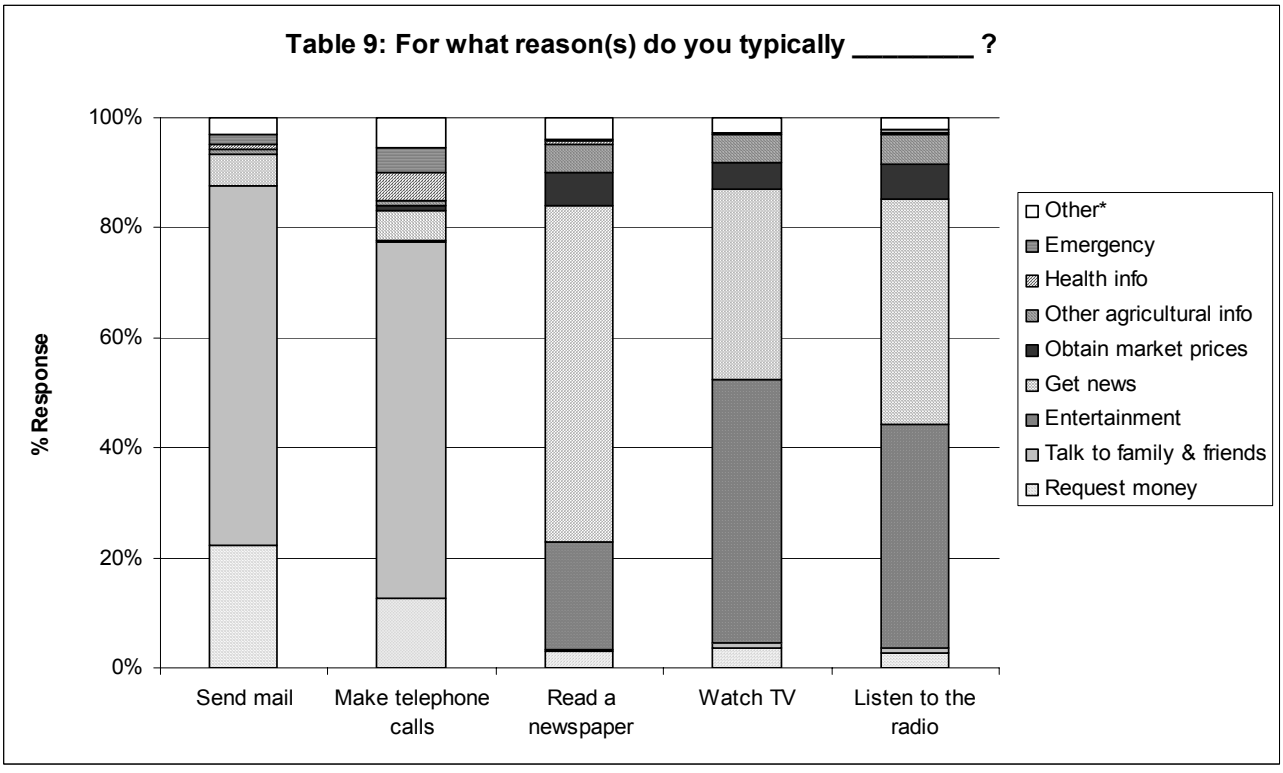


Table 9: For what reason(s) do you typically _____ ?
% Response
100%
80%
60%
40%
20%
0%
Send mail
Make telephone calls
Read a newspaper
Watch TV
Listen to the radio
Other*
Emergency
Health info
Other agricultural info
Obtain market prices
Get news
Entertainment
Talk to family & friends
Request money

Table 10: What is your main source(s) of information for _____?