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ADB Institute Discussion Paper No. 61

Access to Rural Development: Household Perceptions on Rural Development

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ABSTRACT

Rural poverty is linked to the exposure of the households to economic vulnerability through their chronic dependence on agriculture in income-generation. A starting point in mitigating this vulnerability would be a comprehensive accessibility improvement that substantially reduces transportation cost and isolation of the rural communities from basic welfare services. An advocacy campaign and/or incentive system that will encourage private firms to establish operations in rural areas will be needed. More private establishments in rural areas will not only shield the households against exposure to vulnerability but will also serve as a catalyst for microenterprise development. Sustainable rural development will follow provided that there is an ample corporate social responsibility program among these firms to avert widening of inequality. A natural resource management strategy will also be needed for ecological integrity.

Participation is crucial in development project identification to minimize wastage of resources and possibly reallocate it to other productive uses. Provision of rural roads should be bundled properly with support services and capacity-building activities. This can enhance the demand for other infrastructure and services resulting to a dynamic evolution of essential elements in the pursuit of rural development. Bundles of intervention improve production efficiency of rural households at the different stages of production in-farm and/or off-farm.

Rural development interventions should pay special attention to the more vulnerable segment, the farmers especially, with the goal of gradually detaching them from complete dependence on agriculture without putting their food security at risk.

Public investment on infrastructure and user's fees can complement each other in the continuous provision of new infrastructure and maintenance of the existing infrastructure, for a sustainable track towards rural development. The socialized user's fee system is a potential tool for preventing the widening income disparity in rural areas. It is important however to carefully choose a suitable and acceptable basis for the socialized user's fee rates. An incorrect choice can be perceived as a disincentive for access or might stimulate distrust among a segment of the rural society regarding the sincerity of the government in pushing rural development. This might eventually create more social issues rather than bridging inequality.

Keywords: rural development, rural infrastructure, development intervention, household model, spatial autoregression

1 INTRODUCTION

The Philippines is a dominantly agricultural country. Confinement of agricultural production to rural areas often results in the interchangeability of rural and agricultural issues. As of the 2000 census, the population was estimated at 76.5 million with 52% residing in rural areas. Labor migration in favor of urban centers has been a very prominent social phenomenon in the last two decades, causing problems both in rural areas (agricultural labor shortage) and in urban ones (primarily congestion).

A large portion of land is still classified as rural but the contribution of agriculture, fishery and forestry to the gross domestic product (GDP) has been declining since the 70's. In 1975, a few years after the Green Revolution program was launched, the output of agriculture sector accounted for 29% of the GDP. In 1987, under the new administration benefiting from the political events in 1986, the share of agriculture dropped to 25%. Ironically in 1990, more than a year after the implementation of the Comprehensive Agrarian Reform Program (CARP), the share of agriculture dropped further to 22%. In 2005, the structure of the economy was such that service sector accounted for 53%, industries for 33%, and agriculture, fishery and forestry for only 14% of the GDP.

The declining share of the agriculture sector in the national economy may also be taken as a proximate indicator of rural development. The thrust of interventions towards rural development and poverty alleviation has been on the diversification of livelihood activities. This could have potentially contributed to the increasing share of services and industries while keeping a large portion of the population in the rural areas. There are emerging small-scale industries and value-adding activities whose effects yield an increasing share of the industries and services to the national economy. Some formerly urban-operating agencies could also be relocated to the rural areas as a result of the improvement of infrastructure and support services.

Since 1985, the proportion of households engaged in agricultural activities has fluctuated from 34% to 41%, clearly a sign of lower productivity in the sector since GDP contribution is much lower than these numbers. This judgment is further supported by the employment rate in agriculture, fishing and forestry, which was recorded at 43.4% in 1995 and fell to 36.6% in 2006.

Marginalization of households in rural areas can be illustrated by poverty indicators. A comparative poverty incidence in rural and urban areas is given in Table 1.1. In 1985, the poverty incidence in rural areas is about one-third more than that in urban areas. In 2000, rural poverty incidence is more than double that in urban areas, implying that poverty alleviation in the urban Philippines is working much more quickly than its rural counterpart.

Table 1.1 Poverty Incidence of Families in the Philippines

Year	Rural (%)	Urban (%)
1985	50.7	33.6
1988	46.3	30.1
1991	48.6	31.1
1994	47.0	24.0
1997	44.4	17.9
2000	47.4	20.1

Source of basic data: 2003 Family Income and Expenditures Survey, National Statistics Office (Philippines)

Table 1.2 provides the distribution of the population earning less than the food threshold (computed separately for rural and urban households). As early as 1985, almost three-fourths of those falling below the threshold already resided in rural areas. This proportion had increased further by 2000, another possible indicator of the vulnerability of rural households.

Table 1.2 Distribution of Population Earning Less than the Food Threshold

Year	Rural (%)	Urban (%)
1985	71.3	28.7
1988	71.7	28.3
1991	61.4	38.6
1994	66.4	33.6
1997	68.3	31.7
2000	78.1	21.9

Source of basic data: 2003 Family Income and Expenditures Survey, National Statistics Office (Philippines)

Inequality within the rural sector is reflected in Table 1.3. While those in the non-agricultural sector maintained their income deciles from 1994 to 2000, those in the agricultural sector exhibited movement towards the lower income deciles. This illustrates further widening of income disparity among the rural households. While there is no alleviation effect among the non-agricultural households in rural areas, the agriculture sector exhibited a worsening situation. The analysis identified specific marginalized segments: the rural areas in general and agriculture in particular.

Table 1.3 Distribution of Rural Households Across the Income Deciles

Income Deciles	In the Agriculture Sector			In the Non-Agriculture Sector		
	1994	1997	2000	1994	1997	2000
1	20.00	16.25	22.11	10.23	11.00	10.42
2	19.06	16.02	21.43	9.26	15.17	10.72
3	17.68	15.38	19.45	9.52	15.17	10.94
4	14.01	13.96	15.12	11.18	14.92	12.42
5	11.56	11.47	10.42	11.50	12.75	12.40
6	7.73	8.96	5.80	12.09	9.75	11.62
7	4.80	6.72	3.04	11.33	7.67	9.89
8	2.83	5.18	1.48	10.68	4.83	9.11
9	1.57	3.67	0.84	8.40	3.83	7.66
10	0.77	2.40	0.31	5.80	4.92	4.82

Source of basic data: 2003 Family Income and Expenditures Survey, National Statistics Office (Philippines)

What has the government been doing so far? The Official Development Assistance (ODA) fund has been clear about its priorities. In the fiscal years 2002, 2003, and 2004, the fund allotted 20%, 22%, and 19%, respectively, to the agriculture, natural resources, and agrarian reform sector. For the same years, ODA disbursements for infrastructure are 65% (2002), 59% (2003), and 64% (2004). Given that the bulk of infrastructure projects are on road construction, the allocation for infrastructure in general should be beneficial to the rural areas; accessibility is not exclusively for urban households. Government response is not biased against the rural areas after all. What then is the cause of the inequality and marginalization happening among rural households and among farmers specifically? This paper explores some reasons, determinants, and plausible explanations concerning the issues surrounding rural development.

1.1 RATIONALE

This study is motivated by two issues: first, the role of perceptions of the stakeholders in assessing the impact of development projects; second, the role of rural roads in facilitating/complementing the delivery of other rural infrastructure, support services, and capacity-building activities.

Rural development is a very complicated phenomenon; usually it is a long-term and iterative process. Development projects are commonly assessed during the mid-term and after project completion. Many projects are implemented in a medium-period range and by the time of their completion, their real outcomes for rural development have not yet manifested. The success of these projects then is assessed based only on accomplishment of the implementation plan and not on the rural development outcomes. Similar loopholes are duplicated in the design of future projects, and potential outcomes of similar prototypes are seldom integrated into the design. Appleton and Booth (2001) proposed that instead of measuring the final outcome, the intermediate process should be examined through participatory approaches and using measurements based on perceptions.

The sociological perspectives of development point out direct linkages between perceptions and actual economic manifestations. Once the stakeholders exhibit positive changes in their perception, the actual economic manifestation is not far from appearing. Perception changes also contribute/advocate a sense of ownership among the beneficiaries, an important pre-requisite for sustainability. Perception thus will serve two purposes: as a proxy/leading indicator of potential rural development outcome and as a

source of information on how sense of ownership can be advocated towards sustainability. In addition, among conflict areas like many parts of the rural Philippines, peace and development are intertwined, and in such cases, perception can best provide initial indicators of progress in both directions.

Kottak (1991) argues that the desired development targets can hardly be realized if the target beneficiaries' perceptions are not congruent with those of the implementers. This is true in the rural Philippines especially in conflict areas and among indigenous peoples. An infrastructure project is not completely successful in the viewpoint of the beneficiaries if they feel that they were less involved during the identification and in the implementation. The perceptions of the stakeholders can provide valuable insights as to how to adjust the project design, fix the project menu, and other aspects of the project to ensure the greatest possible benefits. The real economic outcomes can be measured later once they begin to manifest. In the meantime, the project implementers can benefit from these perceptions to fine-tune the project perimeters before the funding resources are misdirected.

Perception data can help generate information on stakeholder-initiated (participatory) policy directions and can be used in planning and implementation of rural infrastructure, especially for farm roads. Kottak (1991) warned that development agencies that ignore cultural diversity and adopt a uniform approach to deal with very heterogeneous project beneficiaries may be wasting the already limited resources.

Some important findings from a 2005 survey by the National Development Authority and the World Bank's Asia-Europe Meeting (NEDA-WB-ASEM, 2005) include the value that the stakeholders place on rural roads in stimulating development and the advantages of bundles of interventions over stand-alone interventions. Higher benefits were realized whenever interventions came in bundles as compared to their marginal individual benefits. In both quantitative and qualitative studies, rural roads appeared to be the most favored intervention among the beneficiaries. Certain crops in isolated areas were reported to be unharvested because harvesting and transportation cost could be higher than the farm gate price the traders are willing to offer. This can seriously affect equilibrium and cause the farming system to completely change because it can send an incorrect signal to the farmer that certain crops have no market or are not marketable at all. Improved accessibility should lead further towards provision/facilitation of other needs like post-harvest facilities and training. Delivery of such interventions is facilitated by the improvement of accessibility for the rural community.

Some work regarding the role of roads in rural development is surveyed in the succeeding sections. As a potential contribution to better understand the policy directions needed in targeting rural development, this paper offers an empirical household model integrating spatial dependencies and estimated from perception data. This can help mitigate the wasteful allocation of development assistance in rural areas by identifying where this assistance is needed most and where greater benefits can be expected. Appropriate policies will hopefully resolve the vulnerability and inequality that now characterizes rural communities. Results of the study may also be extended to cross-country comparisons to generate broader policy orientation.

1.2 OBJECTIVES

The main objective of the study is to assess the impact of roads and other rural infrastructure on perception and actual construct (income) of rural development. The main issue to be resolved is the role of a participatory assessment of infrastructure demand to be able to attain higher returns in terms of actual and perceived rural development. Specific objectives include the development of econometric models that

will link the provision of rural infrastructure (e.g., roads) and perceived and actual constructs of rural development. We will also identify bundles of rural infrastructure and capacity-building interventions along with farm roads that will yield optimal impact towards rural development. Finally, we will also assess the impact of perceived demand for infrastructure on perceived and actual constructs of rural development.

Rural areas are typically characterized by agrarian-based economic activities and because of this, oftentimes, *rural* and *agriculture* is used interchangeably. Bale (1999) defined the basic elements of rural development to include social infrastructure, physical infrastructure, and financial services. The interaction of these three elements is expected to push development in rural communities. Rural development is characterized in terms of the manifestation of income and employment, equitable access to productive resources, sustainable development of natural resources and human capital.

1.3 SIGNIFICANCE

As explained above, development project resources may be wasted due to evaluation focusing on implementation efficiency rather than on outcomes. With a participatory assessment of project impact using stakeholders' perception during the course of implementation, the data can be used as input to adjust the project's logical framework. This will help pave the way towards the ultimate attainment of project outcomes. This participatory assessment can also advocate a sense of ownership among the beneficiaries.

The models will provide empirical evidence on the impact of infrastructure, specifically roads, towards rural development. The dynamics in which such development interventions eventually result in rural development will be characterized. The models will also help in projecting the possible effect of a project even before the implementation. The intensity of inputs needed to attain a goal can thus be programmed accordingly. This information can also help identify the bundles or specific types of interventions that are suited for a given community so that resources will not be spread too thin. Bundling of intervention may help reveal how multilateral agencies can pool resources to optimize their impact. The household models may also help explain inequality among rural households. Finally, the study will help generate policy directions that will ensure that development interventions will improve the living conditions of rural households, and that the risk of vulnerability and inequality will be minimized if not completely eliminated.

2 RURAL DEVELOPMENT

Rural societies live in a simple environment, yet the structure and the dynamics of their day-to-day life is complex. Patterns of social processes vary across countries, and even across regions within a country; these patterns are highly sensitive to cultural differences. The study of rural societies has drawn interest not only in development economics but also in many other disciplines. The panoramic view of developing economies is dominated by rural societies. Vulnerability, inequity, and deprivation are common issues confronting rural societies, prompting development assistance/interventions targeting this sector.

Income vulnerability is one major issue confronting rural societies. This issue is strongly interdependent with other thematic issues. In their own initiative to avoid income vulnerability, rural households tend to find ways to augment their livelihood, which is basically agriculture in a limited parcel of land. Their natural strategy for income augmentation often results to excessive, unsustainable use/harvesting of natural

resources. Some examples are clearing of forest for additional agricultural land, logging, over-fishing (even using illegal tools/gear) in inland and coastal water, and intensive crop production resulting in massive environmental degradation. Some join the rural-urban labor migration that has been rampant in the rural Philippines for the last three decades. Initially, such a process is motivated by conflict and social unrest; later and up to the present, poverty and the evolving economic landscape also contribute to the process.

Rural development has become one of the major aims of various assistance/intervention programs of both individual developing countries and of multilateral institutions/donors. A clear understanding of rural development dynamics is necessary for these programs to prosper. In addition, the inadequate indicators of rural development have become a constraint in development planning because an information gap in one of its facets will cripple an integrated assistance program. Thus, any contribution towards the understanding of rural development is valuable.

2.1 RURAL DEVELOPMENT CONCEPTS

The literature offers a wide range of viewpoints on rural development and provides constructs that can be used in measurement/monitoring. Bale (1999) as cited in Government of the Philippines and World Bank (GoP and WB, 2000) defines rural development as including "the provision of social and physical infrastructure, the provision of financial services in non urban areas, non-farm and small-medium enterprises activities in rural communities and market towns that are more closely linked to the rural economy than they are to the economies of the larger urban cities, as well as the development of traditional rural sectors, such as agriculture and natural resource management." The key elements that will facilitate the realization of rural development include social infrastructure, physical infrastructure, and financial services. The dynamics of these three elements will pave the way to uplift the living conditions of rural households. Observing events and issues related to such dynamics can facilitate the measurement of the constructs of rural development.

The rural development strategy for the Philippines is outlined in GoP and WB (2000). It identifies the following: (i) Deepen and implement key structural reforms to help ensure a sustained, higher, and broad-based growth of agriculture, by removing policy and institutional distortions and making the sector more efficient and internationally more competitive; (ii) Facilitate increased and prioritized strategic public and private investments; (iii) Improve natural resource management; and (iv) Strengthen institutional framework, capacity and performance. The Medium Term Philippine Development Plan (MTPDP) also identified outcomes for the rural sector: (i) increased rural incomes and employment; (ii) more equitable access to productive resources; (iii) sustainable development of natural resources/enhanced ecological integrity; and (iv) empowerment of rural communities/human capital development.

2.2 RURAL AND AGRICULTURAL DEVELOPMENT

The prominence of agriculture among rural communities naturally results in linkages between rural and agricultural development. The role of agricultural development in fostering rural development cannot be ignored. The engine of agricultural development relies on facilitating production and efficient utilization of resources among the farming households. The study of agricultural development then boils down to understanding how factors of production (technology, social and economic support services) are efficiently allocated to optimize output/outcome.

One commonly used strategy to complement agricultural development towards rural development is the facilitation of non-farm livelihood. The result (outcome) is essentially

rural income diversification. Empirical evidence provides crucial inputs (see Barrett, et al., 2002 for instance) for the extraction of policies that can result in the diversification of rural income.

How do we stimulate agricultural development? This question is best answered by analyzing each of the factors of production in the context of production optimization/efficiency. The role of land ownership in agricultural production has long been used as a justification for agrarian reform programs in various countries. Farmers will be free to choose a resource allocation scheme that will optimize production if they are not entangled in the bondage of the land, when there is no landlord who decides primarily and may not have direct knowledge of the farming system, deciding solely based on profit incentives. Production is inefficient when the farmer does not own the land. A lower stake may mean a farmer will put forth less effort and will not necessarily grow highly profitable crops (Bandiera, 2002). However, when the farmer owns the land, he or she may opt to plant high-value crops and exert proportional efforts to enhance productivity. Similar observations were made by Larson and Plessmann (2002), that farming households that differ in their ability or willingness to take on risks are likely to make different decisions when allocating resources and effort among income-producing activities with consequences on productivity. Diversification and technology choices do affect efficiency outcomes among farmers, although these effects are not dominant. In a similar context, but on a higher level of empowerment (organized community), Ranis et al. (2001) highlight the linkages between group behavior and economic performance.

There are however, other points of view concerning the land ownership issues. Using a modern theory of agrarian organization, Conning and Robinson (2002) offered a reason why tenure improvement, despite its economic advantages, has been so little used in countries where agrarian reform is a salient political issue, explaining the relative failure of land reform in Latin America.

In the Philippines, resistance among the landowners was very common, so that no tangible results were observed during the first few years after the implementation of the Comprehensive Agrarian Reform Program (CARP). Now that the resistance has been reduced to a few regions, real progress among agrarian reform communities (ARCs) is starting to show. The features of the enabling policies of the agrarian reform law, however, can possibly dampen agricultural development. The CARP allows retention of only seven hectares of land among the landowners, while the tenants can own an indeterminately small parcel of land. The average farm size cultivated by households is just a little more than half a hectare. This prevents farmers from benefiting from technology advancement and other farm implements because doing so with such a small parcel is not cost-effective. This criticism is consistent with the observation of Mundlak et al. (2002) that new technology changed the returns to fertilizer, irrigated land and capital, all of which proved scarce to varying degrees, partially explained by farm size. Since much of the production is done on small farms, increasing concentration of production on small farms can contribute to declining productivity.

Development policies can also lead towards the opposite of what has been expected. Boothroyd et al. (Eds., 2000) observed that in Viet Nam, the lack of appropriate balance in agricultural/industrial and rural/urban development deprived the necessary endogenous factors for development. Streams of people have surged into towns and cities, crowding into slums and leaving behind a destitute, miserable countryside. Analyses by policymakers and leading scientific researchers led to a conclusion that because of the small scale of agricultural cooperatives, conditions were not conducive to a re-division of labor in the direction of centralization and specialization that would promote enhanced production.

2.3 INFRASTRUCTURE AND DEVELOPMENT

Development intervention can be broadly classified into four (possibly overlapping) categories: economic infrastructure (e.g., credit, production support); physical infrastructure (e.g., roads, irrigation); capacity building (e.g., training, information dissemination); and support services (e.g., marketing services, facilitation of access to basic social services). Physical and economic infrastructure has been emphasized from the start but it seems that the policies and other implementing guidelines may have not evolved completely to support development. Progress among developing countries, particularly in rural areas, has been slow. The role of infrastructure in development is emphasized in the literature. In most poverty reduction strategy programs (PRSPs), financing demand usually focuses on infrastructure like roads, potable water systems, and irrigation systems. Some studies that link infrastructure and development are presented.

Theoretical investigation was done by Holtz-Eakin and Lovely (1995), where a general equilibrium model was used and proved that public infrastructure affects factor prices, intermediate prices, and allocation of factors across sectors. The aggregate output of the manufacturing sector however is not affected. Cowie (2002) pointed out that gain in productivity (referring to a railway system) is not necessarily due to form of ownership but on the organizational strategies implemented.

Rural areas are characterized by isolation, lack or inadequate provision of basic amenities, inadequate health and social services, etc. Isolation needs to be resolved to enable the other issues to be resolved. Farm roads facilitate access to the major supply source and market destinations. Roads are expected to facilitate the reduction of costs for transportation of farm inputs and for bringing the produce to the market. Although Glaeser and Kohlhase (2003) focused on peri-urban centers, they reported an efficient road system would enable an estimated 90% reduction in the cost of transporting goods. Lowering transportation costs has such implications as: people are no longer tied to natural resources, consumer-related natural advantages become more important, population is increasingly centralized in a few metropolitan regions, people are increasingly decentralized within those regions, high-density housing and public transportation become increasingly irrelevant, location of manufacturing firms is not driven by proximity to customers or suppliers, and provision of education.

Although the economic importance of infrastructure is supported, some negative social consequences may be present as well. Dams, for example, are perceived to contribute towards sustainability of irrigation. They are also costly and controversial, but Dulfo and Pande (2005) emphasized that less is known about their impact. In an area where dams were constructed in India, production has not increased but poverty has. Among areas benefiting from irrigation, production increased, but those residing in the areas that become flooded because of the dam suffered substantial economic losses, thus widening inequality. It was argued however that as a whole, dam construction results in worsening poverty because no safety nets were provided to the disadvantaged segment of the community.

The localization of infrastructure development polices was studied by Demurger et al. (2002) in China with the conclusion that there is geographic inequity of growth. There is a perception that coastal areas in China benefit from preferential policies, but this is actually because of deregulation policies that allow them to link to the international economy. Instead of imposing back regulations, the expansion of deregulation to inner provinces can help improve growth speed. Infrastructure development to improve accessibility of inner provinces is needed along with human capital development towards poverty alleviation.

Countries that use infrastructure inefficiently are effectively paying for growth at a much higher rate than are those that use infrastructure more efficiently (Hulten, 1996). Capital stocks (infrastructure) that are not efficiently used would render marginal growth for additional capital formation. This usually happens when infrastructure identification lacks community participation, resulting in supply-demand mismatch. Furthermore, new investments (capital) need not indicate economic growth, while efficient use of such translates into real growth. Hence, maintenance and sustainability are more important than putting up more new investments.

The effect of public infrastructure on Philippine agriculture has been established. Teruel and Kuroda (2005) used a trans-log cost function framework augmented with public infrastructure viewed as fixed input. Infrastructure substitutes labor and intermediate inputs. This supports the public capital hypothesis of complementation between public infrastructure and private capital input. The importance of farm roads in altering input demand and enhancing productivity is also established.

A more advanced econometric approach was used by Fedderke et al. (2006) in analyzing the effect of infrastructure expenditures on long-run economic growth in South Africa. They used a vector error correction model (VECM) and concluded that the role of infrastructure is in terms of raising the marginal productivity of capital and encouraging private investments. This is especially true for roads that generally bring down transaction costs of trading. They found that investment in infrastructure leads to economic growth, but there is weak evidence that this will in turn lead to new infrastructure.

2.4 INFRASTRUCTURE AND POVERTY REDUCTION

Funding of basic infrastructure is essential to progress towards social development (Hemson et al, 2004). Such infrastructure can facilitate rural development and, hence, poverty alleviation. Rural development is closely associated with the empowerment of rural communities, which has to include the encouragement of civil society and public participation in decision making in a democratic culture. The International Labour Organization (ILO, 2005) assessed the dynamics between accessibility and poverty. Isolation of poor communities leads to poor access to basic goods like health and education, common risk factors that result initially in deprivation and eventually in poverty. Rural infrastructure is seen as a means of facilitating access to such goods. Recent experience pointed out that although provision of infrastructure is necessary, it is not sufficient for poverty reduction. Sustainable rural infrastructure development is viable if accompanied by four strategies: local level planning, labor-based technology, small-scale contracting, and a rural infrastructure maintenance system.

The role of community participation in enhancing local public service delivery cannot be ignored. The dynamics between the local governance system, the local administrators, the community, and higher levels of administration can facilitate or be a hindrance to development (DasGupta et al., 2003). The role of community participation is important because of community members' knowledge/understanding of the environment as well as the asymmetries of information among the households and the fact that they are directly affected by the outcomes. A development directed state-community synergy should be enhanced by interventions that could reduce power imbalance among community members, e.g., land reform, development of non-crop source of income, etc. Policies at the higher level of governance can bypass the vested interest of local administrators, thereby becoming more responsive to the needs of the households. Institutional reforms at the local and community levels can be enhanced by various factors, including the generation of community demand for better public goods and services (participatory in nature) in fostering development. This may include

empowerment strategies like capacity building and rural infrastructure resulting in lower transportation costs, access to farm inputs, and access to markets. Improved accessibility will minimize if not eliminate the information asymmetry between the suppliers (of inputs), traders (of produce), retailers (of food products), and producers.

Investigation on the impact on poverty of globalization and growth in non-traditional export was done by Balat and Porto (2005). They concluded that policies that basically expand opportunities for Zambian households to earn higher incomes help in poverty alleviation. To secure higher levels of well being, complementary policies like provision of infrastructure credit and extension services are necessary.

Using the Lao Expenditure and Consumption Survey (LECS) 2 (1997–98) and LECS 3 (2002–03), Warr (2005) regressed per capita expenditure on socio-demographic indicators, area dummy variables, access to some infrastructure, and provincial dummy variables to establish that provision of road access even for the dry season alone could result in poverty reduction (higher per capita expenditure). An even higher reduction would be expected if road access was available during the wet and dry seasons.

In the area of measurements and data collection, Gomez-Lobo et al. (2000) pointed out possible enhancements of the Living Standard Monitoring Survey (LSMS) to generate information that would be useful in the development of policy options towards infrastructure development. It was pointed out, though, that sample design improvements are needed along with data collection strategies to ensure collection of relevant information. Such information is needed both in policy formulation for efficient provision of infrastructure and in linking infrastructure and development.

2.5 COMPLEMENTING RURAL INFRASTRUCTURE AND DEVELOPMENT

Consider the following scenario: a one-kilometer rural road that adjoins the main road vein but is five kilometers away from the production area; a solar dryer facility at the center of the community but without ample storage facilities; a good road network with a well maintained irrigation system but no source of financing to procure production inputs; a credit cooperative but no micro-enterprise that will support its robustness to borrowing and lending behavior of members. Such intervention strategies will sooner or later fail because their inadequacies may outweigh their real benefits in the eyes of the stakeholders. The intention is sometimes noble and fair, but once the resources are spread too thin, the benefits promised will not be delivered. Although it may not look democratic, higher density of interventions in an area (others may not benefit at all at the start) so that each properly planned intervention complements the other may yield multiplier effects spreading beyond the initially targeted community.

Household welfare is measured in terms of changes in consumption level, Chong et al. (2004) used panel data and analyzed it using three subsets: households with the same head between periods, households whose size did not change during the study period, and households with the same head and size during the study period. The subsets are aimed to control exogenous effects of household characteristics on consumption patterns. Benefits are higher among those receiving two or more services than the aggregate of the marginal effect of each of the services. This proves that a bundle of interventions is always better and more efficient than individual, stand-alone interventions.

A neoclassical production function was postulated by Jacoby (2000), who used a semiparametric approach to estimate the road benefits at the household level and compare it across income levels. While the low-income group benefited significantly from the roads, is the benefit was not enough to offset the income inequality among rural

households. Jacoby did point out, however, that in addition to lower transportation costs, farm roads also increase access to basic social services like education and health. Roads will not only reduce transportation costs, but will in the long-run lead to improvement in living condition.

The millennium development goals (MDG) are multi-sectoral, so collaborative intervention is needed to attain them. Fay et al. (2005) highlighted the role of infrastructure in attaining the MDG (relating to children). Infrastructure may have direct effects in facilitating the delivery of health care and access to health services, and indirect effects in contributing to output (GDP) that in turn improves health services provision and the provision of basic services in general.

3 HOUSEHOLD MODELS

The usefulness of an econometric model depends on the soundness of the assumptions underlying the mathematical equation. The plausibility of the model to depict reality is crucial in development studies aimed to understand the patterns and the engines that fuel progress of an economic unit.

Lewis (1984) divided development theories into those relating to short-run allocation of resources and those relating to long-term growth. In the short-run, the main issues include price that does not equate real social cost; unregulated market that constraints productive capacity; and production and exchange governed not by income maximization objective, but rather by other “non-economic” considerations. Decision making in development economics is not done on the sole merits of economics alone, but integrating sociological perspectives as well (social cost, specifically). In the long-term growth, two major issues exist: the search for the engine of growth, and the growth pattern. For the rural poor, a typical package serving as the growth engine includes land reform, infrastructure, production support, and capacity building. Lewis further proposed that the real question is, given an intervention policy, how much change in development indicators do we expect? If so much land will be distributed for tenure improvement, how much increase in rural income is expected? In other words, it is not enough to say that infrastructure leads to income growth; the more relevant information is the amount of contribution expected for a unit of infrastructure added.

To determine the impact of policy reforms in rural economies, the reaction of households to policy shocks was modeled by Taylor et al. (2005). The computable general equilibrium (CGE) model was used, and while the resulting model accounts for the interaction among sectors, it was not able to assess household behavior as a consequence of the policy shock. They proposed a new methodology that combines the advantages of both approaches (household and CGE models). Simulation was used to illustrate the role of the rural market constraints and the heterogeneity of the households in shaping household behavior.

3.1 AGRICULTURAL HOUSEHOLD MODELS

The Hymer-Resnik Model (Hymer and Resnik, 1969) is one of the more prominent agrarian household models used to characterize conditions in various countries. Hymer and Resnik postulated a model of an agrarian economy where the rural household is facing alternatives including nonagricultural and non-leisure activities. The initial stages of the development program can be financed from internal trade creation, they argued. Substitution occurs because of the shift from inferior methods of home production to superior methods based on specialization and exchange. The development problem

focuses on the adaptation of industrial production to rural needs, and the authors recommended that government policy consider two targets: a dynamic industrial sector catering to the requirements of the agricultural sector, and a communication and transport system to facilitate the flow of goods, capital, and labor among all trading partners (rural and urban economy). They further pointed out that social cost associated with increased specialization, even with the enhancement of allocation and division of labor, cannot be avoided. In the absence of adequate redistribution mechanisms, gains from trade will be spread unevenly, and certain sectors may not be able to share the wealth but rather will be marginalized further. This model provides a rationale for the early theories of poverty and inequality.

The observations of Hymer and Resnik may still help in understanding present-day rural household income vulnerability. Because of the growing demand for certain crops/commodities in other areas, information asymmetry between the producer and the consumer increases. The trader then enters into the scene to serve as a broker for such information and invests through commodity financing schemes. While trade flourishes, the producer is compelled to specialize further because of his bondage with the trader, leading to even lower income levels. While many stakeholders benefit from increasing trade, the producers (farmers) who have inadequate information will continue to suffer and become more vulnerable, resulting in glaring income disparities and hence inequality.

Agricultural household models are being recast to reflect the imperfect market environment typical among less-developed countries' (LDC) rural economies (Taylor and Adelman, 2003). These models are used in analyzing how household-specific transaction costs reflect the impact of exogenous policy and market changes in rural areas. Taylor and Adelman assumed a Cobb-Douglas production function, fitted models using data from Mexico, and used it in simulating NAFTA-related policy effects under different market scenarios. They pointed out that income effects of policy changes are usually not equally distributed among rural households, a common feature among household-farm models. They examined agricultural households' behavior in the context of both internal conflicts over resource use as well as the external market and non-market relationships in which they are embedded.

3.2 PARTICIPATORY ASSESSMENT AND MODELING

Data collected through participatory methods used to be analyzed only through qualitative approaches. Such analysis usually provides input data in comparative case studies where a more "successful" story is placed alongside a "failure" to discern factors that can be said to determine "success." Participatory assessment is also used in the development of community-based projects, which use demand-driven strategies that are proven to result in better sustainability prospects.

Regression models using ordinary least squares were applied by Prokopy (2005) to estimate project outcomes in an infrastructure project (water system). Outcomes were measured in terms of household satisfaction, equity in access, and saved time (from water collection). The significant effects of capital cost contribution and level of household participation were established. It was recommended that development projects continue to encourage both contributions and participation, but it was noted that neither ensures payment of tariff (for sustainability). Contributions in terms of user's fees and participation in project planning and in maintenance strategies lead to the beneficiaries' sense of ownership. The sense of ownership, in turn, stimulates the project to become more sustainable. User's fees, however, should be matched with local government subsidies in the initial stage of project maintenance. Gradual withdrawal may be initiated once the sustainability structure is in place.

The thrust of decentralization was argued by Asthana (2003) as an element of participation. The author argued that intuitively, public services provided by those closer to the people are more appealing, a justification for the existence of local governments. The efficiency of such decentralization, however, is not empirically established considering drinking water provision in Central India. This is true in many development projects in the Philippines as well. In agriculture, where the functions of the Department of Agriculture had been delegated to the local government units after the decentralization law in the early 90's, interventions that are direct provision of inputs for production have to go through the local politicians. At that level, the power dyad prevails, resulting in unequal distribution. Aside from the fact that those resources are not necessarily put to optimal productive use, the farming households also developed pessimism towards the role of the Department of Agriculture, so lesser cooperation can be expected for future projects such as training in sustainable agriculture.

Participatory econometric modeling was also done by Rao and Ibanez (2005) for a social fund in Jamaica. The authors concluded that although the funds do not necessarily address the perceived needs of the stakeholders, as project completion approaches, satisfaction of outcomes increases. The causal impact of social funds is traced to go beyond the usual economic outcomes and extend towards improvement in trust and in collective capacity building.

Further on participation, DasGupta et al. (2004) emphasized the diversity of settings in the attainment of institutional changes. This diversity requires the tailor-fitting of interventions at the community level in fostering attainment of development targets. The authors pointed out that the state and community should interact to be able to achieve this, illustrating the real meaning of participation.

4 THEORETICAL FRAMEWORK

The dynamics in a typical rural community are an irony between simplicity in rural life and the complexity of the economic system that is operating. The literature offers diverse theories and perspectives in trying to explain the rural economy. There seems to be a cycle over the years among these theories, postulated, reinvented, reformulated, refuted in some cases, and emerging again in recent literature. Lewis (1984) postulated that in the rural economy, growth is triggered by the initiation of trade. Farmers are producing not just for consumption but also for the demand in other communities. This is a valid assumption once productivity had exceeded the threshold for local needs. Otherwise, if production level is still below the threshold, marginalization and subsequent exposure to vulnerability will dominate rural production with growth hardly manifesting, if not remaining impossible. Intensive intervention will be needed to push the farmers initially to cross the threshold for growth. Growth will naturally push economic activities towards diversity at the community level and possibly (but not necessarily) specialization at the household level.

In a growing rural economy, households cannot be competitive if they refuse to specialize. Given the limited technologies available to them (agriculture and non-agriculture), specialization will help maximize production in the light of economies of scale. As an example, a specific industry for microenterprise development (non-agriculture), specific crops requiring special farming systems (and technology) for agriculture, or even specialization of services offered in a diversifying economic environment, will continue to raise their competitive advantage in that area. Specialization will stimulate efficiency in rural production and possibly curtail certain factors of production (in the hope of attaining efficiency). Among the factors of

production, labor is easily substituted through the choice of appropriate technology, resulting in the displacement of many rural workers. This phenomenon was observed in the rural Philippines, which has been experiencing rural-urban migration for the past two decades or so. A sizeable proportion of labor migration spills over to other countries. In the desire for market efficiency, specialization can actually lead towards inequality because of the unequal utility values placed on different production activities. As Lewis (1984) points out, market efficiency is not the way to reach equilibrium in an agrarian economy; rather, it trades some social costs for gains in trade to serve as an engine of growth. The solution proposed then is empowerment of rural communities. Empowerment can include, but is not limited to, the provision of infrastructure and capacity building. The framework that this study will be based upon revolves around the complementation of infrastructure and capacity building in forging a path towards rural development.

The initial role of the government is neither regulation nor governance but empowerment of local communities, similar to the paradigm proposed by the World Bank in poverty alleviation. Empowerment is defined in this paradigm as “the expansion of assets and capabilities of poor people to participate in, negotiate with, influence, control, and hold accountable institutions that affect their lives” (Narayan, 2002, pp. 13–14). Focusing on empowerment in the framework, market efficiencies can be gradually attained since this will help in narrowing the information asymmetries among the stakeholders (the suppliers, the traders, the market/retailers, and the producers/farmers). The empowered stakeholders would like to gain access to pertinent information before they make specific decisions. Rural roads, other rural infrastructure, and capacity-building activities will enable all the stakeholders to access relevant information of the supply-demand chains for rural/agricultural goods and services. The stakeholders can use such information in the efficient allocation of factors of production.

In the process, the government needs to facilitate the dynamics where the stakeholders interact towards attainment of efficiency. For certain interventions like credit, direct provision of say seed capital may be provided by the government or can be taken from some other forms of development assistance. This is also true for other infrastructure where the initial construction will need money that is beyond the capability of the stakeholders. It is important though to consider that rural infrastructure does not follow similar protocol as in mainstream public economics where cost and maintenance will have to be secured from the beneficiaries through the process of taxation. Many of the rural beneficiaries in developing countries fall short of the cut-off of taxable income brackets. However, direct provision should not be continuously done; the government and donors will have to veer away from direct provision and focus on facilitation to stimulate the participatory environment leading towards sustainability. It is important for the stakeholders to establish ownership, so it is important to encourage them to contribute (in cash or in kind) in maintenance to safeguard the sustainability plan that should be part of the design of the intervention. The notion of a user’s fee is difficult to inculcate among the stakeholders especially because they have limited income and livelihood opportunities. A good advocacy strategy though will help rural stakeholders and they will eventually accept the concept of user’s fee.

In Section 4.5, models will be developed to understand the dynamics in the rural economy. A model for a household that would like to maximize its welfare function will be formulated taking into consideration spatial dimension. The spatial dimension will rationalize site-specific packaging of bundles of intervention. A stochastic frontier model (basically a production frontier) will also be developed with spatial dimensions. The spatial dimension is justified in terms of soil fertility and diversity of economic activities determined by topography, among others. This model will help explain how inequality

among the rural households can be traced to how efficient/inefficient they are in accessing the factors of production available to them.

4.1 ROLE OF RURAL ROADS

A rural road will be defined as an access from the main road network to the rural communities and/or production areas. It is intended to provide an access path for individuals residing in rural communities and as passage for light public vehicles carrying people and/or produce. Transportation cost can be reduced because vehicles carrying farm loads will be cheaper than the human carriers that are still used whenever there is no such road, as in many rural areas of the Philippines.

Farm roads are often constructed as dirt pavement, or are topped with gravel, asphalt, or very seldom, concrete (see Figure 4.1). Usually, only people and light vehicles pass through, but during harvest season, the local government or some community organization may upgrade it so that haulers can reach as close as possible to the production areas. The main road network, called national roads in the Philippines, are usually constructed with concrete materials and are wider. Thus, they accommodate heavy-duty haulers that will collect the produce and bring them to the main distribution depot (which is government or privately owned).

Figure 4.1 Typical Rural Road in the Philippines

The path of rural development from the improvement of accessibility in the rural communities will start from the known direct impact of rural roads. Roads are intended to mitigate the state of isolation of an area—isolation that is a hindrance to the initiation of various facets of development. Improved access roads among the rural households will bring increased accessibility and movement because of lower transportation costs, increasing economic activities. The literature provide a wide range of percentage reduction in transportation cost as a result of putting up new or improving existing rural roads. Regardless of the amount of input infused, rural roads are expected to contribute to lowering transportation cost.

Improvement in road networks starts up the feedback system of input procurement and marketing of produce. The producers are expected to pay less for the inputs of production because of the improvement in accessibility; this lower cost increases the producers' capability to procure more inputs. The different suppliers of inputs will lose their existing monopolies and be forced to become competitive because the farmers will have alternative sources. Marketing will no longer be limited to a few traders; a

negotiable pricing system will be created because transportation cost reduction will open the ceiling of price negotiations. This is of course based on the assumption that commodity financing (usually associated with price ceiling of goods and being unfair to farmers) is no longer practiced or that there is a sustainable credit facility in place. Knowledge of the marketing avenues and the demand for various commodities (to be facilitated by the government) will encourage farmers' diversification of crops and later on, to their specializing in high valued crops that are viable only in the production area (efficiency). Thus, increased production and increased gross value coupled with lower input cost will benefit the farmers in terms of increased earnings.

Improved accessibility will also facilitate provision of basic social services like education and health. Even if such services are not brought right into the community, it will be easier for the households to access those from the town centers or in another community. Social services should result in enhancement of human capital and along with other capacity-building interventions, should contribute to empowering the rural community.

Rural roads will also generate multiplier effects. Foremost, they serve as a catalyst for greater public investment into infrastructure and capacity building. An improved access road will facilitate the construction of a health center (and visits of health professionals), a warehouse for agricultural commodities, and even the conducting of trainings and other capacity-building activities. Provision of other physical infrastructure will be made feasible with easy transport of materials. Then for those positions manned by personnel from outside the community, or for capacity building where resource persons come from outside, traveling into the community will be viable and less time will be spent in transit to the site.

The improved mobility of the households will expose them to outside communities. In this exposure, they may observe prototype development that will serve as a stimulus for their desire to realize similar development in their locality. This desire will then foster a good motivating factor for them to participate in the process of identification of strategies that can lead towards development. This is the start of community building that will later on evolve into a sustainable backbone.

With the growing demand for infrastructure, demand for support services will also increase, requiring more participation on the part of the household in planning and in sourcing for infrastructure and support services. This will stimulate the local government to contribute specifically for sustainability of the infrastructure and support services.

Improved accessibility among farmers (leading to reduction in transportation cost) brings viable input sourcing at reasonable cost. Furthermore, better post-production handling will result in lower post-production losses, yielding a good profit margin for the farmers.

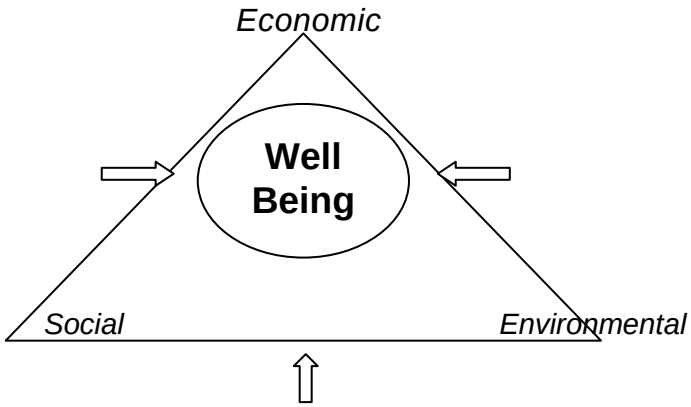
For the non-agricultural household, the direct impact of roads will be in terms of facilitating the emergence of new investments and new enterprises. Eventually, there will be greater diversity in the livelihoods available to them. This diversity is an important manifestation of rural development.

The complementation between increased production among farming households and the non-farming households engaged in microenterprise development are early leads towards rural development. In rural areas where employment opportunities should extend beyond the traditional agriculture basis, the empowered households that

participate in programs will benefit not just the individual households, but will strengthen the entire community as well, contributing to sustainability.

4.2 RURAL DEVELOPMENT CONSTRUCTS

According to the National Economic and Development Authority and the World Bank (NEDA-WB, 2003), rural development is considered to manifest from the presence of three ingredients: social infrastructure, physical infrastructure, and financial services. The fundamental rural development paradigm is summarized in the following:



Rural development results from the improvement of the economic, social, and environmental conditions of the community. These three aspects complement each other and lead towards the overall improvement of individual and community well being.

The rural development and living condition scale and data used in this study come from (NEDA-WB-ASEM, 2005). A Likert scale is used to assess the perception of rural households on the different aspects of living conditions, including 18 items distributed among the different facets of living conditions. The scale was adopted from NEDA-WB (2003), which pilot-tested, validated and improved the instrument. Another Likert scale was also used to assess the perception of rural stakeholders on the different aspects of rural development, including 13 items distributed among the different constructs of rural development. In addition to the validation done in NEDA-WB (2003), the scale was validated further in NEDA-WB-ASEM (2005) to ensure data quality. The details of data collection strategies are given in Section 4.4.1.

4.3 IMPACT ASSESSMENT AND PERCEPTIONS

Impact assessment, participation, and perceptions have become integral elements in strategic development planning. Assessing the impact of similar past interventions can provide valuable lessons on what is effective and what is not, so that the mistakes of the past will not be repeated. Participation and involvement of beneficiaries ensures that the intervention planned to be implemented matches their needs. Perceptions provide a quick yardstick for development planners on the possible/potential impact of an intervention. This proximate measure is a fast alternative to waiting for the quantitatively measurable indicators of rural development, which usually manifest after a mid- to long-term period. Because the beneficiaries are the ones who will receive the outcomes, it is only appropriate that planners incorporate their perceptions into the plans of intervention. Participation and social preparation have become integral pre- and post-activities of rural development intervention strategies.

Here is a statement that further contributes to issues of participation and perception: the views of the stakeholders are considered valuable insights on the accomplishments

of interventions of programs implemented, especially in rural areas (NEDA-WB-ASEM, 2005). While international comparability is easily guaranteed among assessments based on numerical yardsticks, the utility of such measures in the development of strategies for targeted interventions is limiting. Furthermore, participatory assessment has been considered as part of the poverty reduction strategy programs (PRSP) in many developing countries. The development of subsequent interventions (follow through) should be tailored to the stakeholder needs following their perceptions on what is effective for them. This could guarantee the acceptability of strategies and mechanisms of intervention in a much shorter time period, ensuring sustainability of the initial gains that may have been achieved by the predecessor project, parallel to the success of development projects that are backed with ample social preparations. Resource and public economics has similarly gained benefits from using contingent valuation methods that basically derive information from the perceptions by stakeholders in imputing prices and costs of non-traded goods and services.

The literature also includes the work of various authors on modelling with inputs from data on beneficiaries' perception. As an example, Prokopy (2005) measured outcome in terms of household satisfaction, equity in access, and saved time (from water collection) in a water system project. The thrust of decentralization was argued by Asthana (2003) as an element of participation, that public services provided by those closer to the people are more appealing. "Participatory" econometric modeling was done by Rao and Ibanez (2005) for a social fund in Jamaica; they concluded that although the funds do not necessarily address the perceived needs of the stakeholders, towards project completion, satisfaction of outcomes increases. This is especially true among social funds because it is expected that social order must be restored before economic gains will manifest. Participation was further pushed by DasGupta, et. al (2004), who emphasized the diversity of settings in the attainment of institutional changes, therefore requiring the tailoring of interventions to the needs/demand of beneficiaries.

4.4 DATA SOURCES

Data coming from two surveys will be used in the empirical investigation of the models presented below. The client satisfaction survey is one time point (cross-sectional) data collected in 2005 where the unit of analysis is the household. The Family Income and Expenditure Surveys (FIES) have households as the unit of analysis. Public use files (PUF) of these surveys are available for 1985, 1988, 1991, 1994, 1997, 2000, and 2003, but concepts and sampling design have evolved over the years. The design and domain in 2003 are different from those of the previous years. Thus, only the cross-section for 2003 will be used in the analysis.

4.4.1 Client Satisfaction Survey

The Client Satisfaction Survey was commissioned by the World Bank in 2005 (NEDA-WB-ASEM, 2005) to develop a perception-based survey that will facilitate the verification of the effect of the outputs of the rural sector agencies (Department of Agriculture, Department of Agrarian Reform, and Department of Environment and Natural Resources) on rural development in the Philippines. A rural development and living condition scale (see Appendix 1) was developed and pilot-tested several times [see (NEDA-WB-ASEM, 2005) and (NEDA-WB, 2003)]. It was concluded that the scale can approximate the constructs of rural development. The survey was implemented in purposively selected *barangays* (villages) where households were then randomly selected. In the purposive selection of the barangays, prototype interventions of the departments were considered, along with an appropriate control group (no known intervention from the government in recent years). For the government interventions, the strata were defined in terms of whether the project was locally or foreign funded for each

of the three major departments working in the rural sector (agriculture, agrarian reform, and environment and natural resources). The delineation between local and foreign funding serves as a proximate indicator of the intensity of resources used in implementing the project, where resources from local sources are usually lesser than those coming from foreign sources. The control group was also distributed according to expected income level (low, medium, high income), by topography (upland, coastal areas), and according to the Kalaban Laban Sa Kahirapan-Comprehensive Integrated Delivery of Social Service (KALAHI-CIDSS) sites (a government project using an integrated strategy of facilitating rather than direct provisions; it uses a participatory approach rather than imposing appropriate interventions). More than 6,000 households were included in the database. Only rural barangays were included.

4.4.2 Family Income and Expenditure Survey

The Family Income and Expenditures Survey (FIES) is conducted every three years by the Philippine National Statistics Office (PNSO). It is a probability sample of about 20,000 households with rural-urban areas of the provinces as domains (until 2000). In 2003, the domain was raised to the regions and sample size raised to 42,000. More detailed information was collected. This survey's unit of analysis is also the households, but in contrast to the information from the Client Satisfaction Survey, long-term outcomes are collected. Transportation cost is used as a proxy indicator of road system improvement.

4.5 HOUSEHOLD MODEL

Consider a household utility function where profit is indicated by realized or perceived rural development constructs. For perception on rural development constructs, two approaches will be considered: a dichotomous (presence-absence of rural development) one and an index developed from the rural development scale.

In a universal, unregulated intervention, those with more resources (e.g., land or education) will benefit more. This is called leakage of intervention in poverty alleviation strategies, where some intended beneficiaries were not reached while those who do not technically need the intervention actually benefited. In rural communities, such a leakage is very likely to occur especially when the marginalized sectors are still in the empowerment process. As an example, consider a capacity-building program such as livelihood training. Those who have higher education will have a good chance of appreciating the training and have the capability to apply it. They are also likely to have money for capital or may have easier access to credit. Unless a complementing credit program is offered, the more affluent will do better but the marginalized will remain marginalized, the income gap will expand, and the program will result in increased inequality among the rural households. This is also true even within the farming segment. In an irrigation project, the farmers would usually queue for their farm to get irrigation water. A farmer whose cultivated area is large will practically take most of the service time of the irrigation because he needs it. This may also result in greater inequality because by the time the small farmers access the service their paddies are already dried up, leaving them with damaged crops and an even lower income.

Given the natural conditions in a rural economy and the enhancements introduced by the development assistance (infrastructure and support services), the households want to optimize their benefits. The household dynamics aim to optimize their benefits resulting in improvement of their well-being. Such dynamics are summarized into a utility function defined as follows:

For the i^{th} household, define

U_i = utility value for the i^{th} household, which can be defined as

$$u_i = \begin{cases} 1, & \text{if they perceived that there is rural development} \\ 0, & \text{otherwise} \end{cases}$$

or u_i = rural development index derived from the rural development scale;

D_i = demographic profile of the household;

P_i = extent of actual or perceived participation of the household in community activities or in maintenance of infrastructure (in cash, in kind, or willingness to contribute in maintenance);

I_i^1 = indicator variable that the household perceived that there is an available infrastructure/intervention that is needed in generating farm or non-farm income;

I_i^2 = indicator variable that the household perceived that there is an available infrastructure/intervention but this is not needed in generating farm or non-farm income;

I_i^3 = indicator variable that the household did not perceive availability of an infrastructure/intervention that is needed in generating farm or non-farm income;

F_i = factor intensity for farming activities, e.g., farm area, access to credit, farming systems;

NF_i = factor intensity for non-farm livelihood, e.g., age of the household head;

X_i = income from farming activity;

Z_i = income from non-farming activity;

Y_i = total household income; and

w_i = a measure of spatial distance.

Let $\pi_i = \dfrac{P(u_i = 1)}{1 - P(u_i = 1)}$ for the dichotomous case, $\pi_i = E(u_i)$ for the continuous case, and assuming linear contribution of the factors, for a household with farming activity,

$$\pi_i^1 = \beta_0^1 + \beta_1^1 D_i + \beta_2^1 P_i + \beta_3^1 X_i + \beta_4^1 (F_i - \mu_1) - \beta_5^1 (F_i - \mu_1)^2 + \beta_6^1 I_i^1 (F_i - \mu_1) - \beta_7^1 I_i^2 (F_i - \mu_1) - \beta_8^1 I_i^3 (F_i - \mu_1) + \delta^1 w_i^1$$

$$\text{or } \pi_i^1 = f^1(D_i, P_i, X_i, F_i, I_i^1, I_i^2, I_i^3, w_i^1; \beta^2, \delta^1).$$

Similarly, for a household with non-farming activity,

$$\pi_i^2 = \beta_0^2 + \beta_1^2 D_i + \beta_2^2 P_i + \beta_3^2 Z_i + \beta_4^2 (NF_i - \mu_2) - \beta_5^2 (NF_i - \mu_2)^2 + \beta_6^2 I_i^2 (NF_i - \mu_2) - \beta_7^2 I_i^2 (NF_i - \mu_2) - \beta_8^2 I_i^3 (NF_i - \mu_2) + \delta^2 w_i^2$$

$$\text{or } \pi_i^2 = f^2(D_i, P_i, X_i, F_i, I_i^1, I_i^2, I_i^3, w_i^2; \beta^2, \delta^2).$$

Remarks:

1. The quadratic and centered terms on F_i and NF_i are intended to account for a threshold effect of farm and non-farm inputs. Because of the natural constraints in rural areas, the effect of inputs on utility begins to taper as input increases further after it has crossed a certain threshold. As an example, given farm size, production increases proportionately to farm size, but once it crosses the agrarian reform program threshold (e.g., 7 hectares in the Philippines), the utility of the household will start to taper off because they have to turn over excess land to the program. Consider education: initially, as education increases, higher non-farm income may be expected, but as education increases further, that will become redundant, exceeding the level needed in the area, so utility is expected to diminish afterwards.

2. I_i^1 is a perfect match of supply and demand for development intervention that can result in increasing utility, while I_i^2 and I_i^3 are mismatches and are therefore expected to yield negative effects. Something being available and perceived not to be needed will stimulate the stakeholders to ask questions about prioritization of interventions, threatening their perceived utility. The same is true for something perceived to be needed but not being available.

3. The last term accounts for spatial dependence indexed by w_i^1 and w_i^2 (e.g., average perceived utility in the community). The stimulus of some utility perception for a household in the community can also be realized by other households in the same community. This term allows later on the empirical verification of the advantage of targeted, site-specific intervention over universal intervention that usually results in leakage among non-target beneficiaries.

4. The spatial component of the model postulated as an autoregression may also account for the long-term, cumulative effect of the determinants. This serves as a proximate measure of the lag effect of some indicators in the absence of panel data that would facilitate the explicit estimation of the effect.

5. Rural roads and other infrastructure like irrigation need not be treated in the same way as ordinary public goods where maintenance and initial investments are expected to be recovered in a taxation system. Among the rural households in the Philippines for instance, a significant majority earn income far below the minimum taxable level. Therefore, rural infrastructure should be maintained through a user's fee system alongside the support of other stakeholders like the local government.

For the i[th] household, the total odds of having perceived that there is rural development is $\pi_i = \lambda\pi_i^1 + (1-\lambda)\pi_i^2$, where $0 \le \lambda \le 1$. The boundary conditions pertain to the exclusivity of household activities, $\lambda = 0$ if the household is engaged in non-farming activities only, and $\lambda = 1$ if the household is engaged in farming activities only.

The total income is $Y_i = X_i + Z_i$, determined by $X_i = \alpha_0^1 + \alpha_1^1 D_i + \alpha_2^1 P_i + \alpha_3^1 F_i + \alpha_4^1 I_i^1 + \rho^1 u_i^1$ (assuming linear effect) or $X_i = h^1\left(D_i, P_i, F_i, I_i^1, u_i^1, \alpha^1, \rho^1\right)$ for farm income, and $Z_i = \alpha_0^2 + \alpha_1^2 D_i + \alpha_2^2 P_i + \alpha_3^2 F_i + \alpha_4^2 I_i^1 + \rho^2 u_i^2$ or $Z_i = h^2\left(D_i, P_i, NF_i, I_i^1, u_i^2, \alpha^2, \rho^2\right)$ for non-farm income. The last term of the models for income accounts for spatial dependence; a simple indicator is average income for the whole community in which the household is located.

Consider a measure of inequality $P = P^q(y_1, y_2, ..., y_n)$, where n = total number of households and q = number of households with income below the poverty/food threshold. Some examples of P include the Gini coefficient, $G = \frac{\sum_i^n \sum_j^n |y_i - y_j|}{2n^2 \bar{y}}$ where y_i is the income of i[th] household, or the Foster-Greer-Thorbecke Index (Foster et. al., 1984) given by $P_\alpha = \frac{1}{n}\sum_{i=1}^{q}\left(g_i / z\right)^\alpha$, $\alpha \ge 0$ where y_i = per capita income, z = poverty line, g_i = z-y_i called the poverty shortfall, q = number of poor households, and n = total number of families. Constraint in the model can be specified in terms of a target on the level of a measure of inequality.

The objective of a utility-maximizing household is to maximize $\pi_i = \lambda\pi_i^1 + (1-\lambda)\pi_i^2$ given the total income $Y_i = X_i + Z_i$ and the inequality-averse constraint $P_0 = P^q(y_1, y_2, ..., y_n)$, where P_0 is some targeted poverty level. The constraint can be used so that funds intended for poverty alleviation will not be siphoned away by the segment above the threshold z from the marginalized segment in the process of maximizing their utility function. The constraint is attained when non-farm income increases while farm income is low. Both the expansion in farm and non-farm incomes can be realized whenever the intervention package is bundled so that the pre-requisite factors of farm production and skills and capital for non-farm income generation can be efficiently utilized. A household that may opt to concentrate on farm production can produce optimally (as supported by the interventions). This is also true for a household that has the skills to generate non-farm income. All households are expected to expand income and other utility benefits, hence reducing income disparity.

The first–order conditions for optimality of the utility function can be derived by forming the Lagrangian function L(.), and subsequent optimization.

4.5.1 "Non-Poor" Households

The non-poor here are those households with income larger than the threshold z. Among this segment of the population, the inequality-averse constraint will not take effect in utility optimization if FGT is used. In FGT, only the income of the "poor" segment is included in the computation.

Contribution of Participation

The first-order condition for optimality of utility subject to the constraint and identity equation is $\lambda\left[\beta_2^1 + \alpha_2^1\right] + (1-\lambda)\left[\beta_2^2 + \alpha_2^2\right] = 0$.

The condition can be satisfied in two cases: (i) participation affects neither utility nor income from both farming and non-farming sources or (ii) participation affects utility and income function in opposite directions. Case 1 is easily satisfied if intervention is still in the early stage of community building. The stakeholders may not yet be able to realize the effect of participation on their utility or on their income. In case 2, utility will most likely benefit positively from participation, being a common objective/target in any community building activity. While they perceive better utility, participation may result in lower income initially because stakeholders allocate less time for their production activities, or because they allot a portion of earnings for the maintenance of the infrastructure. However, this is not expected to hold in the long-term. As participation becomes prevalent in that community, a model shift will occur or the effect of participation will longer be distinguishable because everybody will be participating.

Contribution of Availability of the Needed Intervention

For the infrastructure/intervention perceived to be available and needed in the community (I_i^1), the first-order condition is $\lambda\left[\beta_6^1(F_i - \mu_1) + \alpha_4^1\right] + (1-\lambda)\left[\beta_6^2(NF_i - \mu_2) + \alpha_4^2\right] = 0$. To satisfy the condition, there are also two cases: (i) farming and non-farming factors exceeded the threshold or (ii) farming and non-farming factors do not exceed the threshold. In case 1, access to the infrastructure/intervention will push income to grow but will not necessarily be accompanied by utility improvement. This is the case where the household has enough resources on hand, and will have greater expectations. Thus, although the infrastructure or intervention may indeed contribute to income growth, the

odds of households perceiving rural development will not necessarily increase. In case 2, however, since the available resources to them (inputs of production) are still below the threshold, having perceived availability of an infrastructure/intervention that is needed will contribute not only to increasing the odds of perceived rural development, but the infrastructure or intervention effect will also manifest in terms of actual income growth.

Contribution of Mismatched Intervention

The effect of I_i^2 and I_i^3 will be similar, both having negative contributions in the utility function and having no contribution in the income functions. Considering I_i^2, the first-order condition is $\lambda\left[-\beta_7^1\left(F_i-\mu_1\right)\right]+\left(1-\lambda\right)\left[-\beta_7^2\left(NF_i-\mu_2\right)\right]=0$. Perceptions such as those associated in I_i^2 or I_i^3 will be optimal if (i) the farming input is less than the threshold and non-farming input exceeds the threshold or (ii) the farming input exceeds the threshold and non-farming input is less than the threshold. In both cases, the seemingly unimportant I_i^2 will have to impact positively if the household resources are still below the threshold (in either farming or non-farming inputs).

4.5.2 "Poor" Households

The poor households are those with income lower than the threshold z. For this segment of the population, the inequality-averse constraint contributes to utility optimization using FGT.

Contribution of Participation

The first-order condition is $\lambda\left[\beta_2^1+\alpha_2^1\right]+\left(1-\lambda\right)\left[\beta_2^2+\alpha_2^2\right]+\frac{\delta}{nz}\left[\alpha_2^1+\alpha_2^2\right]=0$.

This is satisfied when neither utility nor income is affected by participation. Thus, the poor are expected to manifest neither income nor utility improvement as a result of participation. Unlike the non-poor who may already exhibit growth in utility perception, the poor are expected to have income decline as a result of the time and money lost due to participation. That rate of deceleration in income should not pull away the low-income households from the threshold (z); otherwise, the objective function will not be optimized. A more intensive advocacy campaign will be needed so that the poor will able to appreciate the effect of participation later, and will not focus only on the immediate (unfavorable) consequence.

Contribution of Availability of the Needed Intervention

For the infrastructure/intervention perceived to be present and needed in the community (I_i^1), the first-order condition among the poor households is $\lambda\left[\beta_6^1\left(F_i-\mu_1\right)\right]+\left(1-\lambda\right)\left[\beta_6^2\left(NF_i-\mu_2\right)\right]+\frac{\delta}{nz}\left[\alpha_4^1+\alpha_4^2\right]=0$.

The poor households will most likely have farming and non-farming resources that are lower than the corresponding threshold. The optimal solution then implies that such needed intervention perceived to be available contributes directly to income increase (both farm and non-farm). In this case, agricultural infrastructure like rural roads, irrigation, post-harvest facilities, and even capacity-building activities will have direct contributions. On the other hand, the non-farming amenities would also include roads

primarily, since they can stimulate trade and hence the growth of new economic activities leading to the expansion of rural livelihood. Livelihood training programs, credit, and microenterprise development will also have direct effects on non-farm income increase. Therefore among the poor households, the intervention to be implemented should be carefully chosen so that it will have direct benefit to them, and the utility function will be optimized effectively. Participatory project identification will help in this case.

Contribution of Mismatched Intervention

The same effect of mismatched intervention as in the non-poor described in Section 4.5.1 is expected among the poor households.

4.5.3 Other Implications

The perceived need and availability for rural infrastructure and other interventions yield varying effects for the groups above and below a specific income threshold. For the non-poor, access to infrastructure will increase perceptions of income but not necessarily of utility, as they may already have higher expectations. The poor, on the other hand, will benefit in terms of perceived utility improvement that is not necessarily associated with income increase.

To prevent further income disparities among the rural households, the views of the poor on the kind of project should be weighted more than those of the non-poor, who will generally benefit more. To help maximize utility and minimize income disparities, infrastructure or interventions should be chosen so that they will have direct immediate impact on the poor.

Those with lower production capacities should be able to access non-farm sources like participation in trainings or road access in order to avert inequality in income and maximize their utility. This can be done through a screening process for participants of trainings and application of a user's fee based on the ability to pay for physical infrastructure. Households that are assessed as being capable of paying will have less incentive to avail infrastructure, say, irrigation service. They will then procure their own irrigation, say an underground water irrigation type, therefore allowing more marginal households access to the irrigation system. The intervention would thus settle among the targeted beneficiaries. On the assumption that the local government unit is really concerned about the services they will deliver, they will also have a utility function that can be maximized when the households are satisfied with services, i.e., when the trainings/infrastructure becomes "sustainable."

Among agrarian reform communities, those who are efficiently collecting user's fees are more developed. Even in some social fund recipient areas in the Southern Philippines, road user's fees are collected using methods similar to economic rent for natural resources. Regular nonpayment of user's fees, for example irrigation dues, will result in curtailment of their privilege for their farm to be irrigated. Anything free is always viewed to be beneficial. Credit has always been perceived to be a dole out strategy. However, there is already a growing realization among the stakeholders that there is no such thing as a free lunch. There is an emerging paradigm shift from direct provision (favorable to politicians) to facilitation (sustainable) of access to various development amenities. When the role of the national government gradually shifts towards facilitation, the only way to sustain the project is to let the stakeholders participate in the maintenance (in cash or in kind). Such participation stimulates their sense of ownership of the infrastructure, hence increasing the prospects of sustainability.

The constraint then should not be imposed on utility maximization, but rather in the maintenance and sustainability of the intervention. For infrastructure, a user's fee system can be used not only to generate resources for maintenance, but also as an instrument in averting inequality (or at least to prevent it from further worsening). The user's fee system shall consider three factors: (i) capacity to pay—this will help curb inequality, as the "better off" will contribute more than the marginalized group; (ii) economic rent—it is fair that those who benefit more from an infrastructure will contribute more for its maintenance; and (iii) willingness-to-pay—this should be considered because the user's fee might become a disincentive to use among some beneficiaries. Willingness-to-pay is easily encouraged through an effective advocacy campaign.

The constraint for inequality does not directly impact the utility-maximizing households. It is natural behavior that when development intervention in any form is available, rural households will take advantage of whatever benefit it may yield. Hymer and Resnik (1969) pointed out that inequality in an agrarian economy can worsen because of the increasing trade with the outside economy becoming more beneficial to a certain "advantageous" segment and detrimental to the marginal sector.

4.5.4 Estimation

The model has several variables and a good number are dichotomous (dummy) variables. Estimation using least squares may be affected because the design-matrix can become ill-conditioned. Estimates may yield reverse signs, so sensitivity analysis on each independent variable may not be feasible. Forecasting/prediction may still be viable, however, even when the least squares method is used in the presence of ill-conditioning in the design matrix.

To resolve the potential problem caused by ill-conditioning in the design matrix, the backfitting algorithm is used in the estimation. The algorithm assumes that the postulated model is additive, a generalization of the linear regression model. The model is expressed as a sum of basic functions that can be linear, non-linear, or non-parametric. The additive model is given by

y = α + $\sum_{j=1}^{r} f_j(x_j) + \varepsilon$. The function f can be of the form $f_j(x_i) = \beta_j x_j$, ε are independent of the *x*'s, $E(\varepsilon) = 0$, and $var(\varepsilon) = \sigma^2$. The backfitting algorithm described by Hastie and Tibshirani (1990) enables additive model-fitting using any regression-type estimation mechanism, given by:

(i) Initialize: α = ave(y_i), $f_j = f_j^0$, $j = 1,2,\ldots,r$

(ii) Cycle: j = 1,2,...,r

$$\hat{f}_j = S_j\left[\left(y - \sum_{k \neq j} f_k\right) \Big/ x_j\right]$$

(iii) Continue (ii) until the individual functions do not change where S_j denotes a smoothing of the response ***y*** against the predictor $\boldsymbol{x_j}$.

Smoothing may reduce to ordinary least square for simple regressions (one-at-a-time) if the functions are linear.

4.5.5 Specification of Variables

The response variables are total income and the rural development index (standardized so that values range from 0 to 100). The total income coincides with farm income if the household derives all income from farming, non-farm income if it earns

income from non-farm sources, and the aggregate of farm and non-farm income if it derives income from both sources.

The survey design imposes constraints in the choice of inputs of production (farming) among the households. Some proximate indicators were considered in lieu of real production inputs so that the production function becomes comprehensive. This will provide a rationale for the estimates of technical efficiency. The following inputs of production will be considered: area cultivated, access to irrigation, access to and utilization of credit (as proximate indicators of procurement of farm inputs or capital availability for non-farm activities, a requirement for the development of small-scale industries), whether single or multiple crops are planted (proximate indicator of farming system), health indicator of household members (as proximate indicator of human capital), number of household members with work (non-farm), and tenure of work. Two dummy variables will also be included: $S_1 = \begin{cases} 1, \text{if household derived income from farming activities} \\ 0, \text{otherwise} \end{cases}$ and $S_2 = \begin{cases} 1, \text{if household derived income from non-farming activities} \\ 0, \text{otherwise} \end{cases}$. If the household derived income from both farming and non-farming sources, then $S_1 = S_2 = 1$. The interaction between S_1 and farming inputs, and S_2 with non-farming inputs will be included to ensure that causation between output and production inputs are appropriate.

5 RURAL INFRASTRUCTURE AND DEVELOPMENT

The effect of rural infrastructure along with other determinants of production on rural welfare is analyzed at the household level. Household analysis based on perceptions can provide almost instantaneous feedback on various activities geared towards rural development. Causation is better seen using perceptions instead of income measures, which may take a considerable lag time before they exhibit effects. Although income manifestation is a long-term outcome, it should also be carefully factored into the analysis for validation purposes.

5.1 THE RURAL PHILIPPINES

The rural population in 1990 was estimated at 53% and decreased slightly to 51.9% in 2000. Considering the higher population growth rate in rural areas compared to their urban counterparts, it is imperative to reconcile this growth rate with the declining rural population. A common explanation offered in the literature for this discrepancy is the rural-urban labor migration. During the period 1990–2000, diversification of income sources in rural areas was just starting and very few non-farm livelihood opportunities were available. In 2003, the rural households accounted for approximately 62% of all households. Few household members relocated to urban areas (temporarily) but the households remained in the rural area. Also in 2003, the proportion of agriculture households (at least one member is in agricultural production/labor) is very low at 26%.

Rural-urban migration may generate both positive and negative implications. A positive effect could be that there is better road network, motivating the rural labor force to become more efficient in income-generation by going beyond the rural community. A negative effect is less agricultural labor available for efficient production. Rural-urban migration may also obstruct rural development because those “better” qualified human capital that could have been potential conduits for development are the ones leaving rural areas. On the other hand, since some rural migrants may have less sufficient skills

for the demands of urban jobs, they might end up stagnating personally or could become burdens to the urban community, which is already laden with social problems. More insights on rural-urban migration in the Philippines are provided by Concepcion (1978), De Jong and Blair (1994), Gonzales and Pernia (1983), Pernia (1977), and Slater (1977).

5.1.1 Rural Income and Expenditures

All the variables/indicators presented here are measured at their 2003 levels. Family size is comparable in rural areas at 4.88 to their urban counterpart of 4.75. There are more nuclear-type families in rural areas (82%) than in urban ones (75%), a situation explained by the usually cramped spaces in urban centers forcing family-related households to live together in the same housing unit. Furthermore, more single-detached housing units are reported in rural areas (97% compared to 83% in urban areas), explained by the difference in availability of space. The rural population is younger, possibly because those who have entered the labor force have migrated to the urban areas. Prevalence of an employed spouse in rural areas (36%) is similar to that in urban areas (37%).

In terms of amenities and other living condition provisions, the rural areas are disadvantaged with 66% having strong roof materials (88% in urban), 60% have strong wall materials (85% in urban), and 60% with hygienic toilet (87% in urban). Availability of potable water in the community is “rare” in rural areas with 31% relative to 71% in urban areas.

There is no significant difference in the proportion of employed household members in rural and urban areas at 42% (note: this should not be compared to the measure of the employment rate because this proportion is computed at the household level). Although a large proportion of the rural individuals are still engaged in farming, fishery and forestry (45%), there is evidence of gradual expansion of employment opportunities in other sectors with unskilled laborers (17%), operators and other skilled workers (6%), and wholesale/retail trade (7%). Individuals reported to be self employed are high at 45%, evidence of the gains from the efforts towards various interventions geared towards expansion of livelihood in rural areas, a strategy in the poverty reduction program of the government. Employment in a private establishment is reported by 26%, but this is almost doubled among their urban counterpart at 42%. A possible gap in the strategy for rural development can be traced to the development of private rural establishments that will contribute to the sustainability elements of rural development.

The total expenditure of a rural household is only 47% of that among urban households. Given that the poverty threshold in rural areas is about 15% lower than that in urban areas, our earlier assessment of further inequality risk among rural households is supported. Although rural expenses for electricity, gas and water are only 41% of their urban counterpart, this does not mean that these services are cheaper in rural areas. Rather, the discrepancy is due to the fact that the rural households are using these amenities less frequently. Petroleum expenditure in rural areas, however, is 40% higher than that in urban areas, a possible indicator of the accessibility problem.

Land is a major agriculture capital but other expenditures incurred in some agricultural activities are very high as well. In crops and gardening, total expenditures are about 30% of gross income; the corresponding amounts in other activities are 43% in livestock raising, 31% in fishing, and 27% in forestry.

In the wholesale and retail trade, the proportion of expenditure to gross income is similar for both the rural and urban areas. This may be explained by the distribution

system of manufacturers of many consumer goods that deliver the supplies directly to the retail outlets as part of their promotional strategies, thus effectively shouldering the transportation cost. It is more costly to manufacture in the urban areas than in rural areas, where most raw materials originate. Transportation cost is lower in rural areas, while it is bloated in urban areas. Cost of production in the transportation sector is expectedly higher in rural areas than in urban ones.

Total income among rural households averages PhP 102,877, which is only 47% the income of their urban counterparts. Although the non-agricultural income source among rural households has been expanding, the income is still low at PhP 75,836, only 35% of the average non-farm income in urban areas. Although the number of non-agricultural income sources is growing, quality still needs further improvement to facilitate bridging of the income gap among rural and urban households. The savings rate among rural households is 15% while it is 17% among urban households.

Using nationally determined income deciles, rural-urban inequality is further emphasized in Table 5.1. In urban areas, the median income is way up in the 7th decile, indicating that over half of the urban households are among the well-off 30% nationwide. The reverse is true in the rural areas, where about half of the households are in the bottom 30% nationwide.

Table 5.1 Income Decile Distribution of Rural-Urban Households (2003)

Income Deciles (1-Lowest, 10-Highest)	Rural Households (%)	Urban Households (%)
1	16.03	1.66
2	15.30	2.70
3	14.32	4.38
4	12.65	6.67
5	10.60	8.97
6	8.54	11.52
7	7.11	13.36
8	6.05	15.07
9	5.28	16.54
10	4.12	19.13

Source of basic data: 2003 Family Income and Expenditures Survey, National Statistics Office (Philippines)

5.1.2 Rural Household Perception on Development

The rural households surveyed in 2005 to provide perceptions on certain development issues have heads that are mostly married (83%), a good proportion of heads that are college level/graduate (22%), and 17% are female-headed. The households are also relatively young, with an average of 43% of members below 21 years old. As indicated in the previous section, nuclear family types are very common in rural areas with 73% of the households fitting into this category. The rural electrification project seems to get an indication of success with 82% reported to have electricity connection; rural households pay an average of PhP 367 for the monthly bill.

Since the samples were purposively selected to reveal the perception of those who have actually benefited from infrastructure and other development assistance, 65% indicated that income is generated from farming activities, while 74% indicated that they generate income from non-farm activities, in agreement with our earlier analysis of expanding non-farm activities among rural households. The main source of income

though is still agriculture, with 53% indicating that income is derived mainly from agriculture, fishery and forestry. The incidence of small-scale entrepreneurs was at 19% in 2005.

Crop diversification and multiple cropping have long been advocated by the Department of Agriculture. The response is slow, but there is already evidence that farmers are starting to diversify from the traditional rice (31% reported to plant the crop) and corn (15% are planting) agriculture. Livestock (6%), bananas (6%), and other high-value and cash crops are already being planted by the farmers. Even with the availability of irrigation, rice and corn production intensities have not increased considerably because most of the farmers still plant the crop once a year.

The effect of the Comprehensive Agrarian Reform Program (CARP) has been a disincentive to cultivators to maintain a large land area, also an important determinant of agricultural development. The average farm area is only 0.86 hectare, with more than half of the farmers cultivating less than half a hectare of land. They further reported that some farm areas are upland (0.32 hectare) and non-irrigated lowland (0.29 hectare). Expectedly, tenure has improved with 34% reporting that they own the land they cultivate. There is still a need to further enhance tenure because 15% still reported as tenants.

Although only 15% of those who have non-farm livelihoods are engaged in full-time employment, professions are gradually increasing in variety.

There is still a need to push further advocacy campaigns on the understanding of credit. A large percentage (71%) of the households still believes that credit should be provided by the government. A consolation though is that 75% already believe that credit provided by the government should be repaid. Cooperatives are the most popular source of credit; in fact, cooperatives and credit are interchangeable terms for some stakeholders. A good number (26%) are aware that credit is available from the cooperatives, but only 9% actually accessed it. The low access rate can be attributed to the fact that the rural society considers a loan as a negative value. Interest rates are also “disincentives,” especially if collected in the form of a discount. Among those who actually accessed loans, the most popular purpose was for home financing (11%), followed by farm improvement (8%), commodity financing (6%), production loan (6%), and livelihood (4%).

Access to basic social services is a good yardstick of welfare benefits. For their health, the households rely on government hospitals as well as private ones. The situation is not ideal, however, because some households reported that they still consult those who practice traditional medicine and the counter staff of pharmacy stores. Prevalence of water-borne diseases and chronic ailments are low, but infection-related symptoms like cough and fever are still high, possibly an indication of the immunization coverage in rural areas.

Principal component analysis was used (NEDA-WB-ASEM, 2005) in indexing the living condition and rural development scale. To facilitate the assessment, the index based on component scores was re-scaled so that values range between 0 and 100, where 0 indicates absence and 100 indicates complete agreement that there is rural development (or living condition is ideal). While living condition yields an average score of 62.30, rural development is lower with 55.15. The average of total income per household is PhP 110,482. The average income from agricultural sources is PhP 30,518 and that from non-agricultural sources is PhP 78,570.

Among the 18 scale items pertaining to living conditions, **"Water is safe for drinking"** got the most agreements from the respondents (84%). Other items in the top five most agreed to by respondents are: **"Toilet is hygienic"** (79%), **"Housing unit is comfortable for the family"** (79%), **"Water resource is accessible"** (76%), and **"It is now easy to take public transportation"** (67%).

Three items pertain to the water and sanitation aspect of rural development. The 1990's witnessed massive support from multilateral agencies on major water and sanitation projects not just in the Philippines but in other developing countries as well, especially in countries in Africa. In the early part of the decade, feasibility studies were conducted and later followed by the construction/rehabilitation of the physical infrastructure. It was also during this period that sustainability plans were considered a vital element in the project design, and the notion of user's fees was advocated and was gaining gradual acceptance among stakeholders. Many of such water projects are still working to this day with "regular" rehabilitation by the user's group (using user's fees collected), the local government, or through development assistance.

Public transportation, which is synonymous with road projects, is one of the most appreciated interventions by the stakeholders. This is a benefit from the construction and rehabilitation of rural roads, but only 67% agree to the scale item that transportation is easy. This low proportion can be explained by the difficulty in the institutionalization of sustainability measures. Unlike the water system where the beneficiaries have direct contact almost every day, the importance of roads is sometimes taken lightly. A user's fee is very difficult to advocate, taxation is a remote possibility since most of the rural households are earning income below the minimum taxable income, and the local government is difficult to rely on because the term for local public servants is only three years and the complicated political system is a disincentive for them to allocate funds for the maintenance of rural roads. The main roads (called national roads) are maintained by the national government, and in many instances, the local government would like to pass on the responsibility maintaining rural roads to them.

Although income remains low in rural areas, perceptions on living conditions are relatively better, a clear indicator that the intervention efforts are gaining grounds towards attaining the target outcomes.

On the other hand, the five scale items receiving the least agreement are: **"There are enough jobs available now"** (23%), **"There is enough training on possible livelihoods"** (32%), **"There is enough training on new farming techniques"** (35%), **"Our living conditions now are much better than 5 years ago"** (39%), and **"Income is more regular"** (41%). These perceptions can be viewed to be indicators of the demand for more sustainable interventions like new job generation and training on livelihoods and new farming techniques. Although there are intervention packages that implicitly target these issues, many are still inadequate in support for livelihood expansion. Another view of these perceptions is that the stakeholders are already open to the intervention paradigm of facilitation of access rather than direct provision of production inputs.

The rural development scale includes 13 items. Agreement to these items is generally lower than agreement to the items in living conditions. The living condition scale may be viewed as a direct, more immediate manifestation of development, while the rural development scale is a medium- to possibly long-term outcome. Among the top three items that most respondents agreed to, **"Government's effort on agricultural research is important"** got the highest with 60%. It is remarkable for the rural households to appreciate the value of research. This may have been gradually

inculcated to them on various trainings and extension in which they have participated. Agricultural research is an important ingredient of sustainable agriculture. Appreciation of the beneficiaries on this effort is a good start. **"Ecological integrity can be maintained while there is development"** was agreed with by 49% of the respondents, and this was followed by **"The rural sector participates in the discussion on development issues"** with 47%. The effect of advocacy campaigns may be seen to be sinking in, since they are now aware of development and environmental issues and their role in various processes involved. The rural stakeholders are now open to the participatory type of intervention.

The items that generated the least agreements are: **"There are enough employment opportunities"** (21%), along with the parallel item (for consistency check) **"There is enough employment/livelihood in the area"** (25%). These perceptions are consistent with what households said about the living conditions above. **"The poverty reduction strategy of the government is effective"** for 26% of the respondents. This means that about three-fourths of the respondents do not agree that these items are true or they are indifferent to such. Employment and livelihood expansion/diversification, which are usually organic to poverty reduction strategies, should be revisited and updated. There might be a discrepancy between what is planned or programmed and what the beneficiaries are actually capable of adopting among the livelihood and other income-expanding activities.

5.1.3 Household Perception on Development Interventions

Households were surveyed to provide perceptions on availability, actual access, whether it is needed, whether they were satisfied when they accessed it, and whether they think access is effective, of the homogeneous, interrelated outputs (rural infrastructure, support services, and capacity building) by the rural sector agencies in the Philippines. The scale used is given in Appendix 2.

We shall focus on the top/lowest five available, accessed, needed, satisfied, and effective interventions (details are contained in Appendix 3). An overwhelming 85% of the respondents are aware of the construction of health centers in their communities. Of those who are aware that these are available, 78% actually used them, while 83% said they are indeed needed. Among those who accessed the centers, 73% said they are satisfied, while 72% agreed that they are effective (in the provision of basic health services). The distant next most available infrastructure/support services/capacity-building interventions are: rural roads, distribution of high quality hybrid seeds/planting materials, fertilizer support, and irrigation. While interventions were known to be available, not all households accessed them. A significant number also believe that these are not needed. A good preparatory team who would conduct participatory needs assessment and an advocacy campaign could help bridge the information gap here. Effectiveness and satisfaction from access of such interventions received even lower assessment scores. This can be attributed to possible loose ends in the implementation strategies. Not providing intervention is sometimes better than intervention with a half-baked, not carefully planned implementation strategy.

Beneficiaries generally set high regards to something provided for free. However, among the top five most available interventions, only two are direct provisions (seeds and fertilizer support); the other three are infrastructure interventions that will facilitate access to factors of production and can enhance rural living conditions. This can further be interpreted to mean that the rural households may be ready for a shift in rural development intervention from direct provision of factors of production to facilitation of access to such.

The interventions least perceived to be available are support services and capacity-building activities, including training and information on community-based management of resources, training on microenterprise development, support services on market information, market linkages, and commodity volume accumulation. The proportion of respondents who are aware of such services ranges from 9 to 11%. Given that these interventions are not known to be available, awareness of their usefulness is a problem. The rural households cannot yet understand/appreciate the importance of these interventions, but once they are clearly introduced, people will learn to value them and the interventions may possibly stimulate development.

Marketing support for the farmers has been planned many times in the past, but the usual conflict always crops up from the virtual isolation of many producing areas. In the 1990's, accessibility among rural areas was very poor. Now that the beneficiaries already indicated availability of such accessibility means, marketing support can again be re-examined, not necessarily starting from scratch.

With a thoroughly planned advocacy campaign, the beneficiaries are amenable to contribute to the maintenance of rural infrastructure. The importance of rural roads is well-appreciated by the households. A good proportion of respondents (67%) are willing to contribute either cash or labor in the maintenance of rural roads. Sustainability of water systems depends so much on the routine maintenance that should be done. This is recognized by the stakeholders and 58% indicated willingness to contribute/participate in maintenance of water systems. The unresolved institutional issues associated with irrigators' associations and the groups looking at other post-harvest facilities may have prompted households to volunteer lesser support in the maintenance (irrigation with 43%, other post-harvest facilities with 47%).

5.2 RATIONALE FOR THE MODELS

Two classes of models were developed to characterize the household utility function. Logistic regression was fitted for a dichotomized response to the scale item on whether or not the household perceived rural development. Then the rural development scale was aggregated into an index using principal component analysis. With the index score and data on direct questions on farm, non-farm and total income, the models postulated in the framework presented earlier were estimated through a spatial autoregressive model, using the hybrid backfitting algorithm (Landagan and Barrios, 2007). The bulk of variables in the equations (mostly dummy variables indicating perceptions on infrastructure and other development interventions) led to the supervised backward elimination of variables to trim down a few redundant variables.

The use of an index based on perceptions alongside actual income measurement is intended to validate the assumption that perceptions can provide early lead on the potential outcome (rural development) early on during the implementation of an intervention.

Sparse spatial autoregressive models are also developed using a nationally representative sample, the 2003 Family Income and Expenditure Survey. The income data from the survey can be viewed as an indicator of the medium- to long-term development outcome. Income and transportation cost reduction are long-term outcomes after tedious dynamics among stakeholders. A long process from the construction/rehabilitation of roads must happen before they eventually reduce transportation cost. Because there is no direct indicator on availability of rural roads from the data set, expenditures on certain production inputs, cost of economic activities, and transportation costs are used as proxy indicators.

5.3 RURAL HOUSEHOLD DYNAMICS

We will present in this section the household model dealing with utility maximization and production in the short-run and the characteristics of the long-term income outcomes. The potential determinants available in the database are used to control for inherent heterogeneity, but we focus particularly on those concerning rural infrastructure and other development interventions.

5.3.1 Rural Household Models

Logistic regression reveals ($p<0.000$) the relationship of the dichotomous response on whether the household perceives rural development explained by various factors of production, community participation indicators, diversity in income and livelihood, and availability and need for various rural infrastructure and other development interventions. With the default cut-off probability of 0.5, 65% of the perceptions can be correctly predicted from the model, with sensitivity of 41% and specificity of 82%. The households that think that there is no rural development are much easier to understand than households who believe that there is rural development, justifying our earlier claim about how complex the rural development process is. The complete results are in Appendix 4.

The rural development scale was converted into the rural development index (RDI) using principal component analysis. The index was then regressed on various determinants using the hybrid backfitting algorithm. Two spatial distance measures were added: average of the response (RDI) per region and per site. The different sites actually represent the different types of homogeneous interventions provided by the government. Results presented in Appendix 5 yield a mean absolute percentage error of 14%, with only 10% of the sample data points resulting to an error beyond 30%.

Alongside perceptions on various aspects of rural development, income data was also collected. With farm income as the response and using a spatial distance measure at the regional level along with other determinants of income, an additive model was fitted also via the backfitting algorithm. The results in Appendix 6 yield a very low mean absolute percentage error (MAPE) of 3%, indicating good fit of the model to the data. Furthermore, only 5% of the observations yield MAPE exceeding 10%. For non-farm income, results are summarized in Appendix 7, also indicating good fit with a MAPE of only 6%, and 90% of the sample points yield predicted non-farm income level with error <12%.

5.3.2 Utility Maximization

The utility function of the households as a benefit from rural development is measured using an 18-point scale. From the scale, there is a direct question on whether or not they believe there is rural development. This item was dichotomized and logistic regression with a spatial distance indicator was fitted. Responses to the 18 scale items are also aggregated into an index and sparse spatial autoregression was fitted. The determinants for both the dichotomous response and the index are presented below for each group of determinants.

Demographic Determinants

A household's intention to migrate can be an indication of one or a combination of the following: there are not enough livelihood opportunities in the current location, preference for a job or a living environment different from the present, dissatisfaction with the present living condition, and many other reasons. Those who do not intend to migrate

have 19% higher odds of perceived rural development than those who intend to migrate. This indicator also positively contributes to the rural development index ($p<0.024$).

A family member reported to have cough (that needs consultation) results in lower (-24%) odds of perceived rural development for the household. Having a cough is an indicator of the state of health conditions among household members. A household member reported to have been confined in a government hospital may indicate insufficient means for the household. This leads to a lower rural development index for the household as well ($p<0.026$).

A higher proportion of household members 6–12 years old attending school leads to a higher rural development index ($p<0.007$). This also means that school is now more accessible or available (due to roads, construction of a school building in nearby communities). Increasing access to this basic social service is an empowerment mechanism, one of the prerequisites for rural development.

Fewer dependents below 12 years old ($0<0.035$), more working members over 21 years old ($p<0.003$), and having a member employed in agriculture, fishery, and forestry ($p<0.040$) also contributes to raising the rural development index score for the household.

Participation

Community participation is one concrete step towards empowerment of the stakeholders. Some participation indicators appeared to contribute positively to raising the rural development index score or the odds of perceived rural development among the respondents. Those who reported to be members of an irrigators' association have a 91% higher chance of perceiving rural development than the non-members, members of a farmers' organization have 29% higher odds than non-members, and even membership in an ordinary community organization can increase the odds of perceiving rural development by 25% over non-members. Membership to irrigators' organizations and community organizations also contribute positively to the rural development index score of the household.

Not only will it help facilitate the implementation of sustainability provisions, but willingness to contribute in the maintenance of roads ($p<0.004$), irrigation ($p<0.047$), and other post-harvest facilities ($p<0.000$) also increases the rural development index score for the household.

Tenure, Farming Systems, and Ownership/Possessions

Favorable factors of production and possession/ownership enhances households' perceptions of rural development. A household having an electricity connection has 56% higher odds of perceiving rural development than one having no connection. Those with strong wall materials will have 38% higher odds of agreeing that there is rural development. Ownership of a sanitary toilet ($p<0.000$) and having strong roof materials ($p<0.011$) will also increase the rural development index score of the households.

As expected, increasing farm income results in an increasing rural development index ($p<0.015$), confirming further the validity of the index as a good measure of rural development level as perceived by the households.

An amortizing owner of the land being cultivated will have 92% higher odds of agreement that there is rural development, while those who inherited their tenancy status have 43% lower odds of perceiving rural development. As tenure improves, there is

evidence that the perceptions of the households improve, and as a result, that rural development is perceived to be present.

Increasing cultivated area ($p<0.000$) results in improving perception on rural development. This generates necessary criticism of the agrarian reform law that limits ownership of agricultural land. As postulated in the framework discussed in Section 4.5, squared mean-adjusted age ($p<0.049$) also contributes positively in the rural development index.

Access to Other Development Interventions

The households were asked if the homogeneous outputs of government agencies working on the rural sector are available, if they accessed these interventions, and whether they are needed. Availability and need for certain interventions yields positive contributions in their perceptions on rural development, while availability of interventions that are not needed can diminish their perceptions on rural development.

Among the interventions intended to increase agricultural production, availability even if it is perceived to be not needed (perhaps respondents have not yet realized the intended need) of training on planting technologies can increase odds of perceiving rural development almost three times. Availability and perceived need of training on multiple cropping can increase odds of perceived rural development by 12%. Availability, even if perceived as not needed, of training on hybrid variety also increases the rural development index score for the household ($p<0.010$). Availability of training on pest management, if perceived to be not needed, can reduce by more than half respondents' odds of saying that there is rural development. This is also true for community nurseries and training on new planting technology. The reason for the decline in chances of perceiving rural development in cases where non-needed interventions are provided is that the stakeholders may have realized the inefficiency in the delivery of such interventions.

Post-harvest and marketing supports are also included in the list of homogeneous outputs of the government in the rural sector. Availability and perceived need for support in volume accumulation (needed to empower the farmers to negotiate for prices) increases the likelihood of perceived rural development by 17%. Support in marketing information also contributes to the rural development index scores of households ($p<0.003$). Perceived need for a warehouse (but lack of availability) with available (but not needed) support for market linkages leads to a lower rural development index, proving the inefficiency of spreading resources intended for development intervention too thin. If support for market linkages is provided, volume has to be accumulated and stored in a warehouse, and the rural roads must be viable so that transportation cost will not shoot up to offset the potential earnings for the farmers.

Empowerment of the community and active participation on development issues by rural households are best achieved through the organization of a cooperative. Once organized, sustainability can be ensured through advocacy efforts among the members and cooperative management trainings for the officers. Those who perceived that training on cooperative management is needed but is not available have 80% lower odds of agreement that there is rural development.

Those who noted that training on community-based management of resources was available and needed would have the tendency to score low in the rural development index ($p<0.008$). This can be attributed to a possible problem in the design of such training programs.

Availability of training on off-farm livelihoods, even if they do not yet think it is needed, can increase the households' likelihood of believing that there is rural development by 96%.

Access and Perceptions on Credit

Although credit is not new in development interventions, many of its features are still not correctly understood by the stakeholders. There is still a need for an intensive advocacy campaign to emphasize the intended benefit from a credit program. As mentioned previously, there is still a strong belief among the rural households that credit should be provided by the government. Those who think that credit is the government's responsibility have 29% higher odds of perceiving rural development. Even if credit is to be provided by the government, the encouraging finding is that respondents now agree to repay the loan. About a decade earlier, many rural credit facilities in the Philippines failed because of the very low repayment rate attributed to the misunderstanding that is the credit was a dole out from the government coupled with real incapacity among the borrowers to pay because of the inherent design defects of the system.

Knowing that there is an available source (cooperative) in case of financial needs increases the likelihood of the household's belief that there is rural development by 27%. Knowledge of availability of credit from a government bank ($p<0.022$) and other government financial institutions ($p<0.000$) also increases the rural development index score for the household.

Those who accessed credit from cooperatives have higher rural development index scores while those who received credit from other government financial institutions have lower scores. The stringent policies in more formal credit facilities may have contributed in the decline of household utility even if in the long-run, interest rates from cooperatives become exceedingly high. The laxity in the availment and payment scheme among the cooperatives has been very attractive to the farmers. Credit from more formal financial institutions like rural banks can improve the borrowing system of cooperatives to attract more farmers to access their services.

Availability and need of loans for agricultural production and actual availment have lower utility for the rural households, resulting in lower rural development index scores. Availment of loans even for the purpose of enhancing agricultural production is still creating a stigma of incapability among the farmers. They believe that it is a threat for their dignity to have borrowed money. Advocacy strategies should take these beliefs into consideration.

Bundles of Infrastructure/Interventions

Some common groups of infrastructure and other development interventions that are usually bundled together are tested for their simultaneous effect on the perceptions of stakeholders. This will contribute to resolving the negative effect of stand-alone interventions and finding the answer to the less efficient strategy of spreading resources too thin.

A bundle of training on farming (pest management, planting technology, farm machineries, harvesting methods, use of hybrid varieties, multiple cropping, and crop selection) will not necessarily increase the utility of the households. In fact, their likelihood of agreement that there is rural development is 20% lower if they perceived availability of the training bundle. This is a case when even if the intervention is a bundle, if there is no lateral support before and after this bundle in the production chain, it will be useless. Trainings aimed to increase production should also be accompanied by support

in the input acquisition and in post-production processes until marketing to ensure optimal benefit.

Training on off-farm livelihood and the provision of credit intended for livelihood generation and microenterprise development are good tandem programs that can increase the likelihood (38% more) that the household will perceive rural development. In-farm livelihood, credit, and rural roads, on the other hand, result in a 49% reduction in the chance that the household will perceive that there is rural development. Possible explanations could be faulty design, especially of the in-farm livelihood, or that interventions were implemented piecewise (perhaps at different time frames), so the integrated effect is not realized.

A training program on microenterprise development with credit facilities bundled with rural roads is one ideal combination of interventions included in the bundle. Those households who perceive availability of the bundle have 79% higher odds of agreement that there is rural development, in addition to the increase in their rural development index scores. An in-farm livelihood training with a credit facility but without a rural road that is needed results in the decline of the rural development index scores of the households.

Unless there is an appropriate vertical support for an intervention in the production chain, the effectiveness measured in terms of rural development cannot be expected. Efficiency of development interventions can be guaranteed if they are bundled together. Intensive intervention in a site is more optimal than spreading resources to many sites.

5.3.3 Household Production (Farm Income)

The rural households generate income from either farm or non-farm sources. Traditionally, the rural economy has been known to be agrarian. However, having all of the income of rural households coming from farm sources is not sustainable because farmers are highly vulnerable to weather and other environmental conditions. The rural economy is easily toppled by a major typhoon, a devastating infestation, a drought, and many other occurrences. Also, as trading intensifies, new economic sectors are created, opening alternative opportunities for the households. Diversification of economic activities provides a remedy to the vulnerable condition among the rural households. Thus, rural development is also gauged in terms of how much non-farm income is generated. However, a continuous supply of food should also be ensured, so the behavior of both farm and non-farm incomes are considered important indicators of rural development. We will present in this section some determinants contributing to farm income generation and in the next section we will do the same for non-farm income.

Demographic Determinants

Since farming has been a life-long activity among farmers—usually one passed on over generations—none of the usual demographic attributes contributed to farm income generation. Having attended high school ($p<0.000$) or college ($p<0.001$) means lower farm income for the household. Usually, the educated members of a rural household would have alternative livelihoods; preference is usually on non-farm-based activities.

Participation

Members of key organizations like generic farmers' organizations ($p<0.000$), cooperatives ($p<0.016$), irrigators' associations ($p<0.000$), and credit organizations ($p<0.000$) have higher farm income compared to the non-members. Membership in the organization is a usual pre-requisite to be prioritized or in some cases to be able to avail of the services provided by the organization. Physical infrastructure like irrigation and

roads, and economic infrastructure like credit and input merchandising (usually done by farmers' organizations) needs efficient management for maintenance and sustainability, which are the usual tasks of organizations. Membership in an organization is not only intended to access the respective services, but will also contribute to the empowerment of the rural communities.

In addition to membership in the different organizations, those who indicated willingness to contribute to the maintenance of irrigation ($p<0.000$) and post-harvest facilities ($p<0.000$) also benefit in terms of higher farm income. The organizations sometimes curtail the privilege of members to avail services if they have defaulted on their contribution for the maintenance (repayment for credit or procurement of input).

Tenure and Farming Systems

Philippine agriculture has long been dominated by rice and corn. The bulk of the programs in agriculture focused on the production and distribution of these crops. They are also considered political commodities: these programs usually receive the largest chunk of the total budget for agriculture. Thus, planting rice ($p<0.000$) or corn ($p<0.000$) easily contribute to raising farm income of the rural households. The cumulative benefits from the programs geared towards rice and corn production are easily translated into farm income. Furthermore, although corn is generally planted only once a year, those who attempted to plant more than once a year ($p<0.001$) also generated higher farm income. This means that once-a-year production for corn is not yet optimal.

Those who plant coconut ($p<0.000$) or industrial crops like rubber ($p<0.000$) and those who raise livestock ($p<0.000$) also have higher farm income. Although coconut is not a high value crop, the opportunities for multiple cropping interspersed among the trees can help increase farm income. Industrial crops will definitely have price premiums, while properly conducted livestock-raising can be very productive and raise farm income as well.

A larger area of cultivated land—regardless of type and topography—yields higher farm income. The area of irrigated lowland ($p<0.000$), non-irrigated lowland ($p<0.027$), and upland ($p<0.001$) all contribute positively to the farm income of the household. This means that any increases in area cultivated regardless of type can lead to an increase in farm income. Increasing area improves not only households' perception on rural development but their actual farm income as well. Income is not optimal among those with small pieces of land because technology adoption is not efficient in their circumstances. As an example, a mechanical thresher will not be practical if there is only one-fourth hectare of land cultivated, and rentals during harvest season usually shoot up, eating up the intended earnings for the farmers.

As expected, those who own the land they cultivate have higher farm income ($p<0.000$), justifying the need for tenure improvement as an essential component of the agrarian reform program.

Access to Infrastructure

Among the stand-alone infrastructure interventions, irrigation is expectedly contributing significantly to farm income. Those who reported that they need irrigation and that it is available have higher farm income ($p<0.009$), while those who need it but to whom it is not available have lower income ($p<0.016$). Irrigation is one physical infrastructure element that has a direct effect on farm income. Other infrastructure elements like roads would have an indirect effect taking place after the factors of production interact.

Access to Other Development Interventions

Various trainings on production technology affect production, while post-harvest supports preserve the income margins for the producers (the farmers). While the farmers are not necessarily aware of the benefits from these trainings, resulting in a lower perceived utility for them, the actual farm income proves the effectiveness of these interventions.

Availability and perceived need for distribution of high quality seeds and planting materials contributes to raising farm income ($p<0.009$). Although the strategy is not sustainable because this distribution will encourage further dependence on the part of farmers, the short-term effect on farm income is quite clear. If this program can be translated into some similar mechanism, say channeling of resources to research, establishing seed banks/community nurseries, and selling the seeds/planting materials, the strategy will become more sustainable while maintaining a similar benefit. This strategy agrees with the positive effect on income of need and availability for a community nursery ($p<0.020$). Even if there is a need for a demonstration farm and it is available, it contributes negatively to farm income ($p<0.002$), probably because of the inadequate support that will link it to the production chain. An isolated, stand alone demonstration farm will be useless.

The need and availability for training on harvesting methods and use of equipment also yield higher farm income ($p<0.000$). The need for training on use of hybrid variety but non-availability of such can result in lower farm income ($p<0.002$). These are types of complementing activities needed to augment the strategies discussed above in order to stimulate independence among the farmers, resulting in sustainable production support. On the other hand, perceived need, even if the service is available, for training on pest management can have a negative effect on farm income. The design of the present curriculum may not be appropriate or again, there may be inadequate supports to optimize the benefit from the training.

Milling on-farm is expected to add value to the produce and reduce transportation cost. Perceived need and availability of millers contributed to farm income increase ($p<0.000$). As for the need and availability of support in terms of marketing information, a negative effect ($p<0.029$) is observed, a possible consequence of the isolation of the production area. Warehouse and hauling services will be needed between milling and marketing information to produce the optimal benefit among the farmers.

There is a perceived need and availability for training on cooperative management, resulting in increase in farm income ($p<0.001$) because this will facilitate the efficient delivery of services by the cooperative. Training of cooperative members that is not needed pulls down farm income ($p<0.048$) because of the time wasted that should have been spent on productive means in the farm.

Environmental protection is beneficial not only in terms of sustainability but also in farm income enhancement. Those who perceived availability of and need for training or information on the care and management of the environment have higher farm income ($p<0.039$).

Access of Credit

The role of credit in farm income generation is clearly illustrated by the models. Access to loans intended for farm improvement ($p<0.026$), production loans ($p<0.021$), or loans for the procurement of post-harvest facilities ($p<0.033$) contributed to farm income increase. Credit availed from other government financial institutions resulted in

higher farm income, while that coming from cooperatives yielded lower income for the farmers. The usually higher interest rates of cooperatives can partly explain this.

5.3.4 Household Production (Non-farm Income)

As argued in the previous section, expansion of non-farm income is an indication that the vulnerability of the rural household is gradually being relieved. The determinants of non-farm income will provide the necessary directions of strategies that will help alleviate income vulnerability of rural households in general.

There is evidence of complementation among the determinants of farm and non-farm income. This is an indication that while diversity of income sources is pursued, this does not necessarily uproot the farmers from cultivating the land. Hence, non-farm income is not intended to replace farm income, but rather to augment it with the intention of mitigating the vulnerability of the rural economy in general.

Demographic Determinants

To increase the likelihood of generating non-farm income, it is important that the household head is a college graduate/level ($p<0.000$); it is also important that the household includes extended family ($p<0.001$), has a large size ($p<0.000$), has a higher percentage of household members 17–21 years old working ($p<0.004$), and has a higher percentage of household members over 21 years old working ($p<0.039$). While higher educational level is a negative determinant to farm income, the reverse is true for non-farm income. Non-farm employment, entrepreneurship, and other livelihood activities favor those with higher education. The four other indicators indicate that the pooled non-farm income of the household depends on how many household members are contributing.

If the main source of income is farming, fishery or forestry, non-farm income is expectedly lower ($p<0.000$). However, even if the main source of income is identified to be entrepreneurship, non-farm income is still lower ($p<0.005$), an indication of the inadequacy of skills among the rural household in carrying out this economic activity. Aside from the usual microenterprise development as an important livelihood expansion activity in rural areas, they need to be capacitated more on the rudiments of entrepreneurship.

With a household member contributing in terms of foreign remittances, non-farm income increases ($p<0.018$). However, the prevalence of households with foreign remittances is very small. Non-farm income is also increased when there is a household member whose occupation is “professional” because this is among the highest paid types of occupation ($p<0.000$). The more family members engaged in full-time jobs, the more non-farm income is expected to be generated ($p<0.000$).

Access and Perceptions on Credit

Just like in farm income, a clear understanding of the benefits and responsibilities attached to credit availment is important in raising non-farm income. Those who believe that credit provided by the government should be repaid have higher non-farm income ($p<0.021$). The benefit of cooperativism goes beyond the farms: those who are aware that there is a credit facility available from the cooperatives can have higher non-farm income ($p>0.003$).

Good training on livelihood activities coupled with credit facilities intended for livelihood or microenterprise development also increases non-farm income ($p<0.021$).

5.3.7 Long-Term Outcomes of Rural Roads

Income is the only indicator of rural development from the Family Income and Expenditures Survey. The breakdown of farm income and non-farm income will be analyzed separately. Income growth may manifest in the mid- to long-term, but spatial autoregression will help account for the possible lagged effect of the determinants of income. Furthermore, we have filtered households from rural areas only for the analysis.

There is also no direct measurement of intensity of accessibility infrastructure because nationwide data is not available at the household or even at the community level. Some measures of expenditures on certain economic activities will be used as proximate indicators. Although reduction in transport cost is not as instantaneous as the provision of rural roads, the fact that we are also using income as indicator of rural development justifies the causative models.

Non-Agriculture Income

The demographic determinants of non-farm income with positive effects include age of the household head ($p<0.000$), whether the head is married ($p<0.000$), and whether the head's education is elementary ($p<0.000$), high school ($p<0.000$), or college ($p<0.000$). There is a premium for age in non-farm income generation because this is usually associated with accumulated experience/skills and rank. Being married could mean that there is a spouse who can also contribute to the household non-farm income. Furthermore, any level of education is an investment in non-farm income: the higher the level of education, the higher the income returns expected.

A household reporting that income is generated mostly from agriculture would actually have non-agriculture income lower by 53% compared to those generating income mostly from non-agriculture. Even among households in rural areas alone, the vulnerability of the farmers is very clear. Male-headed households also generate lower non-farm income. This coincides with an earlier analysis on the efficiency of female-headed households in income generation. Nuclear families that usually have smaller sizes and those with more members under 15 years old also have lower non-farm income because there are a few members eligible/capable of non-farm employment. This is further supported by having more employed individuals and an employed spouse generating more non-farm income.

Income generated by professional workers is the highest, followed by the operators (usually skilled), and the laborers (usually unskilled). Those in agriculture, animal husbandry and forestry still generate the lowest income from outside the farm. Although there is a gradual diversification of occupation, the goal of alleviating the vulnerability of rural communities has not yet been attained because the indicator of employment in a private enterprise is not significant, while employment in a private household is significant. Not enough income is generated from the private enterprises because there are only a few of them operating in rural areas. The rural enterprises have not evolved yet as planned from being micro to medium (or even small) scale.

Higher expenditures on petroleum, telephone, electricity and water are all functions of accessibility of an area. Isolation of a community can drive all these expenditures high. All these indicators yield significant, negative coefficients in the regression of non-farm income. Furthermore, expenditure on manufacturing activities also yields a negative regression coefficient. Manufacturing requires transportation of raw materials and finished products, so cost of production is closely associated with transportation cost. Improved accessibility infrastructure can indeed generate more non-farm income among the rural households.

Agriculture Income

In as much as agricultural production requires male workers, male-headed households have the advantage of generating more income from agriculture. Strength of workers will have an advantage in land cultivation, so younger people also have natural advantages in agriculture. Education, however, unlike in non-farm income where it has a positive contribution, it is not necessarily needed to cultivate the land. Furthermore, while the younger members of the household (<15 years old) cannot yet get jobs outside the farm and thus have negative contributions to non-farm income, they can be used (and, in fact, are used) as agriculture labor, doing light jobs like planting, weeding, and harvesting, thus contributing positively to agricultural income generation.

Higher expenditures on electricity, water and land transportation are all proximate indicators of availability of access infrastructure. Expenditures on the wholesale and retail trade are usually dominated by transportation cost because the activity requires movement of goods from the producers to the consumers. Cost in the operation of a transport business easily increases when the road system is of poor quality. These indicators also generate negative coefficients in the regression of agriculture income, indicating that accessibility infrastructure affects both the farm and non-farm income levels of rural households. Absence of an accessibility network isolates a place or a community, reducing their productive potential from both farm and non-farm sources.

6 SUSTAINABILITY ISSUES

Massive amounts of development assistance have flowed into developing countries these past decades. Although there has been a dynamic re-shaping of the beneficiaries, including their perceptions as time progresses, the issue of sustainability remains a puzzle. Various prescriptions have been provided on how to facilitate sustainability, but many projects still fail in this aspect. We will assess what the beneficiaries have in mind that can be tapped to develop a concrete plan that will serve as the backbone of the sustainability measures, especially for physical infrastructure.

The stakeholders are realizing that training (farming technologies, livelihood activities, and general purpose trainings) can empower them allow them to gain equitable access to productive resources. Enhanced accessibility achieved through the construction of rural roads will complement various capacity-building activities and microfinancing to facilitate equitable access to productive resources among the rural households. The theoretical elements needed to pursue rural development are now acknowledged by the stakeholders. Thus, with proper packaging of various development interventions, the rural communities are nearly ready to cooperate in the implementation and maintenance facilitated by the government with the support of private enterprises for sustainable rural development.

6.1 SUSTAINABILITY AMONG FARMING HOUSEHOLDS

In 2005, the average total income per farming household was PhP 116,666. Of this amount, PhP 66,562 came from farming while PhP 49,647 came from non-farming sources. The per capita poverty threshold in 2003 was PhP 11,589 (annual) among rural areas, and for a family of 5, this would require an annual income of PhP 57,945, lower than the average income among farming households. By deflating the 2005 income to the 2003 level, 59% of the rural farming households have income lower than the poverty threshold, while 62% of the individuals have household income lower than the threshold. In 2003, the national poverty incidence was 24.4% (rural and urban), a figure remarkably

lower than our estimate for all-rural households. At the regional level, the highest poverty incidence is 47.1% and at the provincial level, it is 64.6%.

While average income for rural farming households is relatively higher, poverty incidence does not look better. Despite the higher average total income, incidence of households and individuals with income lower than the poverty threshold further highlight the inequality in rural areas—especially among those who depend on farming. This is consistent with Hymer and Resnick (1969), who observed increasing inequality associated with rural development. While rural development may have been progressing as indicated by growing average income, farming households are poorly benefiting from such. Their vulnerability is magnified by the natural constraints of agricultural production. Growth of a crop cannot be mobilized (unless a progressive agricultural research program produces a result), and while waiting for the maturity period, there is no other income expected from that crop. In microenterprises, however, productivity can be intensified by increasing appropriate factors of production. Farming households are exposed to the income vulnerability while non-farming households will exhibit robustness, illustrating how rural development can result in further inequality.

The generally higher average income among rural households supports rural development as perceived by the stakeholders, with 43% in agreement that there is rural development and 30% still uncertain about it. Only 27% do not agree that there is rural development. The overall measure of rural development, RDI, also yields a fairly high average of 57.39, where 0 means absence and 100 indicates almost certain presence of rural development.

6.1.1 Credit

An intensive advocacy program on the concept, meaning, and mechanics of credit is still needed so that credit interventions can pursue the benefits they promise to generate among the beneficiaries. For sustainability of credit, universal targeting for such an advocacy campaign will be needed because these perceptions are true even across groups of communities, some of which have even been sites of credit programs of different agencies.

6.1.2 Physical Infrastructure and Other Interventions

Physical infrastructure requires regular maintenance for sustainability; often, it requires substantial financing. Ideally, public investments in general are maintained through a user's fee system collected through taxes (possibly local). In the rural Philippines, however, because many households are earning less than the minimum income tax threshold, for sustainability, maintenance contribution should be collected directly from the beneficiaries. It is important to understand the willingness of the beneficiaries to contribute and to match it with their capacity to pay.

Among physical infrastructure elements, roads seem to be the most promising in the likelihood of their being maintained. Eighty-seven percent of the farming households are willing to contribute for the maintenance of roads, but only 9% are willing to contribute cash averaging PhP106.16 per cropping season. They realize the value of roads especially during the harvest season in addition to availability of cash resources during this period. A good number, however, can contribute labor services (73%), while 6% may lead users' organizations, and 30% can contribute only through careful use of the road. In other words, although they recognize the importance of roads in their productive activities, farmers are not ready to shell out cash for their maintenance, but can supply labor to maintain them. Somebody from the group can be identified and will take the lead

of the organization to maintain the road. Maintenance of roads is perceived to be the concern of the local or national government, a view that explains the lack of enthusiasm among the farming households for providing money for maintenance.

The majority of the farming households (74%) are willing to contribute for the maintenance of an irrigation system in their community. Although about one-fourth are still not ready to contribute, this majority shall be a good start in the development of elements needed in the maintenance and sustainability of irrigation systems. Of those who are willing to contribute, 78% also indicated that contributions would be in cash, 7% in labor services, 7% are willing to help in the management or in providing leadership to the users' organization, and 21% would rather use the facility with care. Those willing to contribute in cash indicated an average contribution of PhP 585.51 per month.

A good proportion (75%) of farming households are willing to contribute for the maintenance of post-harvest facilities. However, only 9% indicated that their contribution would be in cash. The need for such infrastructure arises only during harvest season, explaining their disinterest to contribute cash and their desire to do so only as it is needed, i.e., at the end of cropping season. Even so, a good number (69%) can contribute labor, 7% their leadership/management of the users' organization, and 31% will use it with care instead.

For the water system that provides a supply of potable water, 84% of the farming households indicated willingness to contribute for the maintenance, but only 12% are willing to provide cash at an average of PhP88.19 per month. The majority (71%) are willing to contribute labor services, 5% can lead the users' group, while 32% will just use it with care instead.

Some 78% of the farmers are willing to buy seeds, breeders, planting materials, and other inputs instead of a dole out direct provision to them. This is a good indication that should the Department of Agriculture gradually shift from direct provision to facilitation of access to inputs, sustainability can be expected.

Sense of ownership is an essential input for the sustainability of infrastructure. This can be easily achieved when the stakeholders believe that the infrastructure is indeed what is needed in their community, and when they have taken part in the process of identifying it. An overwhelming 94% are willing to participate in the identification of development projects in their community. This will be a good start for a more participatory development intervention that will eventually lead to greater long-term sustainability.

Maintenance of physical infrastructure requires a viable users' group who should take care of the collection of fees and the actual maintenance of the facility. A fully matured users' group will be responsible enough to collect the fees and use them in the maintenance of the facility. Misuse of users' fees can be avoided when there is substantial transparency practiced by the group officers, and when such transparency is advocated during the organizing and development stages of the group. During the organizing stage, government extension workers may help facilitate the formation of the organization, but should gradually distance themselves from the group and later on can only participate to ensure checks and balances among various stakeholders and officers of the organization.

6.1.3 Contributions of Government Interventions

Among the homogeneous outputs delivered by the national government engaged in the rural sector, the projects that the stakeholder believes to contribute most towards various goals were identified. The question was framed as an unaided, top-of-the-mind response mechanism, therefore soliciting a perception that could have been forming in the mind of the respondents, and not just a result of quick coaching of possible answers.

To increase agricultural production, direct provision of production inputs are viewed as the most important interventions, with fertilizer (14%), irrigation (11%), and hybrid seeds, breeders and other production inputs (8%) at the top. Training and other information on farming technologies closely follow, with 6% recognizing their importance; other general trainings (5%) follow those on farming technologies. Although the stakeholders perceive direct provisions to contribute most to increasing agricultural production, they are gradually recognizing the importance of capacity building on issues regarding modern farming technologies.

When asked about the project that contributed most to increasing income, many identified fertilizer support (14%), closely followed by trainings on livelihood activities (10%). Other responses provided by about 5% of the respondents are seed/breeders/planting materials support, irrigation, post-harvest facilities, and general-purpose trainings. Note that these are mostly production inputs provided with minimal financial counterpart from the beneficiaries. Although the stakeholders think these could help increase their income (because fewer expenses are involved in production), these are not necessarily sustainable because these inputs can lead to perpetual dependence of the farmers on government support, creating a new source of vulnerability.

Improvement of the environment is attributed mostly to trainings and information campaigns on the proper care and management of the environment (12%). General purpose training also helps (7%), as well as rural roads (6%) and training on livelihood programs (6%). General-purpose trainings usually cover advocacy on various issues including environmental concerns and other empowering information for the rural communities and their linkages to outside communities. Rural roads mediate their isolation and will open opportunities that are not threats to the environment, in the same way as the training on livelihood programs work.

It is good that rural households recognize the role of trainings on livelihood in promoting sustainable development (14%). General purpose trainings, training on farming technologies, post-harvest facilities, and rural roads were also identified to contribute to attaining sustainable development. This again acknowledged capacity building that empowers households, along with the necessary support services as the major elements of sustainable development.

In terms of poverty reduction, many farming households chose trainings on livelihood activities to make the biggest contribution (22%). Far below in second place is the provision of credit (9%). Rural roads, training on farming technologies, general purpose trainings, and construction of health centers were also identified to contribute to poverty reduction. Indeed, the households recognized that one strategy for poverty reduction is to remedy their vulnerability from farming through the provision of alternative income sources and the necessary support so that these alternatives will elevate them and allow them to escape further entrapment. Many of those who attempted to explore non-farming livelihoods have been forced to rely on non-formal credit sources that charge exorbitant interest rates, further aggravating their income-generation capabilities. Similar interventions were identified by the farming households to contribute most to improving

living conditions. This further confirms the idea that poverty in rural areas is not necessarily viewed as a state of inequality but rather as having hurdles in accessing amenities in life.

6.2 SUSTAINABILITY AMONG NON-FARMING HOUSEHOLDS

Although there is a lower total income for non-farming households than for farming ones, there are fewer households with income lower than the poverty threshold. This is evidence of the volatility of farm income sources and the relative stability of non-farm sources. Non-farm factors of production are easily accessed by the stakeholders, resulting in lesser inequality in earnings. This further emphasizes the importance of non-farm income sources that cannot be ignored in alleviating the vulnerability of rural households.

Fewer non-farming rural households than farming ones agree that there is rural development (38%). The same is true for the overall rural development index (53.24), which is slightly lower for non-farming households. The difference between farming and non-farming households is consistent even with average income.

6.2.1 Credit

The perceptions of non-farming households on the mechanics of credit are similar to those of farming households. About 72% believe that credit should be provided by the government—a slightly lower proportion than among the farming households. Some 22% are not sure who should provide the credit, but 6% do not think that the government should be the provider. Repayment of credit provided by the government is perceived to be needed for 76% of the non-farming households.

6.2.2 Physical Infrastructure

Rural roads were identified by non-farming households as a major contributor in attaining the different target outcomes in rural development. Respondents said that they should be maintained; 78% of the non-farming households were willing to contribute, but only 11% indicated that they would contribute in cash. The majority (66%), however, committed to contribute in labor services while 4% volunteered to provide leadership or management of the organization responsible for the maintenance, and 37% said they would rather use the equipment/facility with care.

For the water system, 71% of the non-farming households are willing to contribute for its maintenance. Most of the contributions they are willing to provide would be in labor services (63%). Only 15% are willing to contribute cash, while 38% would rather use the facility with care. Some 4% can provide leadership or management in the organization that will do maintenance.

In the identification of development projects, fewer non-farming households (90%) are willing to participate compared to the farming households. There is perhaps a misconception that development intervention in rural areas is synonymous with agriculture. The advocacy effort on development interventions should thus include a significant focus on the clarification of the purpose and goals of the project.

6.2.3 Contributions of Government Interventions

The top-of-the-mind responses of non-farming households to the question on which government interventions contributed most to the different goals differ slightly from those of the farming households.

On the overarching issue of rural development, they identified trainings on livelihood source along with rural roads to contribute the most. Consistent with the theory of the potential role of rural roads, though trainings are crucial, enhanced accessibility will be needed to optimize the translation of such trainings into productive activities. They also identified other interventions like the provision of health centers that enhance welfare through the provision of health services, development of cooperatives for institutional empowerment, and other general purpose trainings for further capacity building. The complex correlation between rural development and sustainable development is acknowledged by the non-farming households, and they believe that similar interventions that contribute towards rural development also contribute towards sustainable development.

Poverty reduction, as perceived by non-farming households, is consistently dependent on three elements: capacity building, access, and welfare. Training on livelihood activities topped the choice of project contributing most to poverty reduction (25%). Credit followed with 10%, while health center construction came next with 8%.

The non-farming households believe that livelihood trainings are very important in improving the living conditions, as identified by 23% of the respondents. Provision of health centers, rural roads, credit, and general purpose trainings are also believed to contribute to the improvement of living conditions.

For income increase, about one-fifth of the respondents believe that training on livelihood activities can contribute the most. Rural roads and credit were also identified to contribute in this aspect. Although they are not engaged in agriculture, respondents think that fertilizer support and training on various farming technologies can also contribute to income growth.

To improve the condition of the environment, the non-farming households agree with farming households that appropriate training and information on the care and management of the environment is needed. Appropriate regulatory services that will manage natural resources and other capacity-building trainings can also contribute.

7 CONCLUDING NOTES

From the complex complementation among the essential elements of rural development—namely social infrastructure, physical infrastructure, and financial services—the linkages of these elements were traced towards the attainment of rural development goals. Income and perceptions were used as indicators in the empirical abstraction of rural development. Income provides an easy link between the sequential goals of rural development and poverty alleviation. Perceptions facilitate tracking of rural development that manifests in the long-run, enabling policies on the provision of development intervention to be adjusted in the course of implementation.

The debate on rural development identified the unsustainable features of direct provision of production inputs. Aside from being expensive, such provision will also encourage further dependence by the marginal farmers, increase exposure to vulnerability, and worsen income inequality. Facilitation for the rural stakeholders to gain access to various tools needed in agricultural production and in other income generation activities will yield broader multiplier effects and have higher chances of sustainability. Rural roads are viewed as the core component in a package that will facilitate the rural stakeholders' access to inputs in income generation. Rural roads will pave the way for other physical infrastructure to be delivered to previously isolated communities. These

roads will facilitate the delivery of capacity-building activities and community organizing that leads towards empowerment of the community. A fully empowered community will then be able to stride on a sustainable path towards development.

Participatory Identification of Development Intervention

The survey illustrated some discrepancies between what is needed and what is available among the interventions from the viewpoint of the stakeholders. Such mismatch results in inefficiency in the utilization of the scarce resources available to the rural communities. A participatory approach is crucial in project identification so that waste of resources will be minimized and resources may be reallocated to other productive uses. It is important to conduct a perception survey to both assess the impact of those interventions already provided and to verify whether they are in accordance with the community needs.

Rural Infrastructure

Rural roads generate the largest impact in rural development index and income growth. Furthermore, the rural households' production (income-generation) potential is also optimized with the availability of an accessibility network that alleviates their isolation.

Providing irrigation systems in a properly identified community necessarily fuels growth in farm income and optimizes their technical efficiency in perceiving rural development.

Income Diversification and Agricultural Growth

While income source diversification is expected to propel total income growth, income from agriculture could suffer as a result of labor shortage in a labor-intensive production system. Gollin, et. al. (2002) argued that low agricultural productivity can substantially delay industrialization. Thus, reversion of the potential negative effect of improvement in accessibility to agricultural production requires that more efficient farming systems be introduced and adopted by farmers. This will sustain agricultural growth while relieving some labor that can take on non-farm income-generating activities, resulting in sustainable income-generation for the family.

Credit

Credit has a high multiplier effect on non-farm income. This illustrates the efficiency and effectiveness of the use of credit for non-farm livelihoods or in microenterprise development. The marginal farmers, however, are in need of capital to procure production inputs, but their repayment rate suffers when crops are destroyed due to weather or infestation. It will be more viable for sustainability of the microfinancing funds to set aside from the loan proceeds premium for crop insurance. On the other hand, credit for livelihood should be provided along with appropriate training on microenterprise development to ensure the efficient use of loan proceeds and later, to guarantee high if not 100% repayment rate.

Credit intended for specific farm activities exhibits a significant contribution to farm income. Among the credit accessed by the farmers, that intended for the acquisition/procurement of post-harvest facilities yields greater contribution to farm income growth. There is a large proportion of post-harvest losses; if appropriate facilities

are procured by the farmers (possibly through a cooperative or an organization for cost-effectiveness), the losses can be converted into farm income.

Bundles of Interventions

Provision of rural roads should be the core of rural infrastructure. It should be bundled properly with support services and capacity-building activities like training to enhance demand for other infrastructure and services, thus resulting in a highly dynamic movement of various elements essential in rural development. Bundles of intervention further improve production efficiency of the rural stakeholders because such bundling will facilitate activities at the different stages of production at the farm or outside the farm.

Income Inequality Aversion and Sustainability

Among the rural households, those in farming still experience inequality in the access to productive resources and their vulnerability is magnified further by the natural limitations of agricultural production. Growth of a crop cannot be fast-tracked (unless there is progressive agricultural on-going research), and while waiting for the maturity period, there is no other income expected from that crop. In microenterprises, productivity can be sped up simply by increasing appropriate factors of production, e.g., labor. This explains the inequality between farming and non-farming households even when there is evidence of rural development. Rural development interventions should focus more on the vulnerable segment, the farmers, and how they can be gradually detached from complete dependence on agriculture, without of course abandoning it completely because food security could also be exposed to risk.

Public investments complemented with amounts from user's fees will result in a continuous provision of new infrastructure and maintenance of the existing infrastructure, leading towards rural development. A socialized user's fee can be considered for two reasons: maintenance (sustainability) and support for the low-income households. This user's fee will gain fair access to infrastructure without being burdened with user's fees, which are sometimes a disincentive given the marginal income they generate. It is important to carefully choose the basis for the socialized user's fee concept because it may also deter the "better off" from accessing the public infrastructure or a common service in the community. They may decide to acquire privately a similar facility that they are capable of obtaining, and this will be a potential threat to sustainability. Advocacy effort is very crucial. It is certain though that maintenance from user's fees is viable from the present income and expenditure structure of rural households.

Private Investments in Rural Areas

The gap in the rural development strategies can be isolated from the fact that there are fewer employment opportunities from private establishments. It is important to encourage or provide incentives to private establishments to establish operation in rural areas. This incentive should primarily consist of accessibility development to reduce transportation cost. Private investments in rural areas can help mitigate the vulnerability of rural households when they become independent from the limitations inherent in agricultural production. Rural-urban labor migration may also be relieved. This will also serve as the catalyst in the development of sustainable microenterprises. Private establishments with a sound social responsibility program can also contribute to mitigating inequality.

8 SUMMARY OF POLICY RECOMMENDATIONS

Participatory Approach: The input of the stakeholders in project identification is important in the efficient allocation of resources and to pave the way towards sustainability.

Infrastructure Development: Rural infrastructure development shall initiate from the construction/rehabilitation of rural roads followed by community organizing.

Income Source Diversification: While income source diversification is important in mitigating economic vulnerability of rural households, it can lead to agricultural labor shortage, a possible threat to food security. There must be continuous research on labor-efficient farming systems for a more viable rural development program.

Credit: An intensive advocacy strategy on credit is needed. A portion of loan proceeds for agricultural production loans should be set aside for crop insurance. Microenterprise development, training on farming technologies, and the concept of a cooperative should be considered among the support services to complement the credit program.

Bundles of Interventions: Bundles of interventions can improve production efficiency of the rural stakeholders at the farm or outside the farm.

Sustainability: For sustainability, development assistance in rural areas should shift towards facilitation of access to production inputs and support services rather than direct provision of such.

User's Fees: Financing for the maintenance of infrastructure should come from public investment complemented with user's fees from existing infrastructure.

Private Investments in Rural Areas: Improvement of accessibility network among rural areas augmented with other incentives can encourage the relocation of private investments needed to push rural development.

REFERENCES

Appleton, S., Booth, D., 2001, Combining Participatory and Survey-Based Approaches to Poverty Monitoring and Analysis, *Background Paper for the Workshop in Uganda*.

Asthana, A., 2003, Decentralization and Supply Efficiency: The Case of Rural Water Supply in Central India, *J. of Development Studies*, 39(4):148-159.

Balat, J. and Porto, G., 2005, Globalization and Complementary Policies: Poverty Impacts in Rural Zambia, *NBER Working Paper No. 11175*, National Bureau of Economic Research.

Bale, M., 1999, The Rural Poor: A Thematic Approach, The World Bank: East Asia and Pacific Region.

Bandiera, O., (2002), Land Distribution, Incentives and the Choice of Production Techniques in Nicaragua, *Center for Economic Policy Research (CEPR) Discussion Paper No. 3141*.

Barrett, C. B., Reardon, T. A., Webb, P., Nonfarm Income Diversification and Household Livelihood Strategies in Rural Africa: Concepts, Dynamics, and Policy Implications, *Food Policy*, 26(4): 315–331.

Boothroyd, P. and Nam, P. X., eds., 2000, Socioeconomic Renovation in Viet Nam: The Origin, Evolution and Impact of Doi Moi, Singapore: IDRC/ISEAS

Chong, A., Hentschel, J., and Saavedra, J., 2004, Bundling of Basic Services and Household Welfare in Developing Countries: The Case of Peru, *Policy Research Working Paper No. 3310*, Washington, D.C.: World Bank.

Concepcion, M., 1978, Growth and Distribution of Population, In Population of the Philippines, Country Monograph Series No. 5, Bangkok: UN Economic and Social Commission for Asia and the Pacific, 10–31.

Conning, J. H. and Robinson, J. A., 2002 Land Reform and the Political Organization of Agriculture, *CEPR Discussion Paper No. 3204.*

Cowie, J., 2002, Subsidy and Productivity in a Privatized British Passenger Railway, *Economic Issues*, 7(1): 25–37.

DasGupta, M., Grandvoinnet, H., and Romani, M., 2003, Fostering Community-Driven Development, *Policy Research Working Paper No. 2969*, World Bank Development Research Group.

DasGupta, M., Grandvoinnet, H., and Romani, M., 2004, State-Community Synergies in Community-Driven Development, *J. of Development Studies*, 40(3): 27–58.

De Jong, G., and Blair, M., 1994, Occupational Status of Rural Outmigrants and Return Migrants, Rural Sociology, 59(4): 693–707.

Demurger, S., Sachs, J., Woo, W., Bao, S., Chang, G., and Mellinger, A., 2002, Geography, Economic Policy, and Regional Development in China, *NBER Working Paper No. 8897*, National Bureau of Economic Research.

Dulfo, E. and Pande, R., 2005, Dams, *NBER Working Paper No. 11711*, National Bureau of Economic Research.

Fay, M., Leipziger, D., Wodon, Q., and Yepes, T., 2005, Achieving Child-Health-Related Millennium Development Goals: The Role of Infrastructure, *World Development*, 33(8): 1267–1284.

Fedderke, J., Perkins, P. and Luiz, J., 2006, Infrastructural Investment in Long-Run Economic Growth: South Africa 1875–2001, *World Development*, 34(6): 1037–1059.

Foster, J., Greer, J., and Thorbecke, E., 1984, A Class of Decomposable Poverty Measures, *Econometrica*, 52: 761–766.

Glaeser, E. and Kohlhase, J., 2003, Cities, Regions and the Decline of Transport Costs, *Working Paper No. 9886*, National Bureau of Economic Research.

Gollin, D., Parente, S., and Rogerson, R., 2002, The Role of Agriculture in Development, *The American Economic Review*, 92(2): 160–164.

Gomez-Lobo, A. Foster, V. and Halpern, J., 2000, Better Household Surveys For Better Design of Infrastructure Subsidies, *Public Policy for the Private Sector Note No. 213*, World Bank Group-Private Sector and Infrastructure Network.

Gonzales, V. and Pernia, E., 1983, Patterns and Determinants of Interregional Migration, In Pernia, et.al., eds., *The Spatial and Urban Dimensions of Development in the Philippines*, Makati: Philippine Institute of Development Studies, 303–317.

Government of the Philippines (GoP)-World Bank Joint Report, 2000, Rural Development and Natural Resource Management: Trends, Strategy Implementation, And Framework Performance Indicator System, Volume 1, Manila: World Bank.

Hastie, T. J., and Tibshirani, R. J., 1990, *Generalized Additive Model*, St. Edmundsbury Press

Hemson, D., Meyer, M, and Maphunye, K., 2004, Rural Development: The Provision of Basic Infrastructure Services, *Position Paper*, Human Sciences Research Council: Integrated Rural and Regional Development.

Holtz-Eakin, D. and Lovely, M., 1995, Scale Economics, Returns to Variety, and the Productivity of Public Infrastructure, *NBER Working Paper No. 5295*, National Bureau of Economic Research.

Hulten, C., 1996, Infrastructure Capital and Economic Growth: How Well You Use It Might Be More Important than How Much You Have, *NBER Working Paper No. 5847*, National Bureau of Economic Research.

Hymer, S. and Resnick, S., 1969, A Model of An Economy with Nonagricultural Activities, *The American Economic Review*, 59(4): 493–506.

ILO, 2005, Mainstreaming Poverty Alleviation Strategies through Sustainable Rural Infrastructure Development (Indonesia), *International Labour Organization: Employment Intensive Investment Programme.*

Jacoby, H., 2000, Access to Markets and the Benefits of Rural Roads, *Economic Journal*, 110(445): 717–737.

Kottak, C. P., 1991, *Anthropology: The Exploration of Human Diversity*, 5th ed., McGraw-Hill Inc.

Larson, D. F. and Plessmann, F., 2002 , Do Farmers Choose to Be Inefficient? Evidence from Bicol, Philippines, *WB Working Paper 2787*, World Bank.

Landagan, O. and Barrios, E., 2007, An Estimation Procedure for a Spatial-Temporal Model, *Statistics and Probability Letters,* 77: 401–406.

Lewis, W. A., 1984, The State of Development Theory, *The American Economic Review*, 74(1): 1–10.

Mundlak, Y., Larson, D.F., and Butzer, R., 2002, Determinants of Agricultural Growth in Indonesia, the Philippines, and Thailand, V. 1, *World Bank Working Paper 2803*, World Bank.

Narayan, D. (Ed.), 2002, *Empowerment and Poverty Reduction: A Sourcebook*, International Bank for Reconstruction and Development, World Bank.

National Economic and Development Authority and World Bank (NEDA-WB), 2003, The Dynamics of Rural Development: Implications of the Intervention of the National Government, under the NEDA-WB TA on Capacity Building on Rural Development and Natural Resource Management: Planned Performance Monitoring and Indicator System, Pasig City, Philippines.

National Development Authority and World Bank's Asia-Europe Meeting (NEDA-WB-ASEM), 2005, The Contributions of the Government to the Rural Sector, under *NEDA-WB-ASEM TA on Poverty Monitoring and Analysis*, Pasig City, Philippines.

National Statistics Office (NSO), 2004, Family Income and Expenditures Survey, NSO, Philippines.

Pernia, E., 1977, The Impact of Migration on Rural Areas in the Philippines, *Philippine Economic Journal*, 16(1&2): 160–170.

Prokopy, L., 2005, The Relationship Between Participation and Project Outcomes: Evidence from Rural Water Supply Projects in India, *World Development*, 33(11): 1801–1819.

Ranis, G., Burmeister, L., Wang, M., 2001, Group Behavior and Development: A Comparison of Farmers' Organization in South Korea and Taiwan, *Yale Economic Growth Center Discussion Paper No. 828*.

Rao, V. and Ibanez, A., 2005, The Social Impact of Social Funds in Jamaica: A "Participatory Econometric" Analysis of Targeting, Collective Action, and Participation in Community-Driven Development, *J. of Development Studies*, 41(5): 788–838.

Slater, P., 1977, Nodal Migration Regions of the Philippines, *The Philippine Statistician*, 26(3&4): 35–41.

Taylor, J. and Adelman, I., 2003, Agricultural Household Models: Genesis, Evolution, and Extensions, *Review of Economics of the Household*, 1: 33–58.

Taylor, J. E., Dyer, G., and Yunez-Naude, A., 2005, Disaggregated Rural Economy-wide Models for Policy Analysis, *World Development*, 33(10): 1671–1688.

Teruel, R. and Kuroda, Y., 2005, Public Infrastructure and Productivity Growth in Philippine Agriculture, 1974–2000, *Journal of Asian Economics*, 16: 555–576.

Warr, P., 2005, Road Development and Poverty Reduction: The Case of Lao PDR, *ADBI Research Paper No. 64*, March 2005.

APPENDICES

APPENDIX 1: SELF ASSESSMENT OF LIVING CONDITIONS

The following is the scale used in collecting perceptions on living conditions in rural areas:

Some issues relevant to your community are listed below. We would like to ask your opinion, idea and some recommendations concerning these issues. For each item below, please indicate your agreement/disagreement whenever applicable. Note that NOT APPLICABLE option is included in case the issue is irrelevant to you. Please tell me what number best represents your assessment as I read each statement. (USE SHOWCARD). READ THE STATEMENT ONLY, DO NOT READ THE ANSWERS, HAND DOWN THE SHOWCARD TO THE RESPONDENT WHILE READING THE STATEMENTS.

0 – Not Applicable 1 - Disagree 5 - Agree (1,2 levels of disagreement, 4,5 levels of agreement, 3 about to agree/disagree)
(The showcard will contain 5 varying faces indicating extent of agreement/disagreement to the statement.)

1 Housing unit is comfortable for the family	5	4	3	2	1	0
2 Toilet is hygienic	5	4	3	2	1	0
3 Cost of electricity is reasonable	5	4	3	2	1	0
4 Water source is accessible	5	4	3	2	1	0
5 Water is safe for drinking	5	4	3	2	1	0
6 Water cost is reasonable	5	4	3	2	1	0
7 School is more accessible now	5	4	3	2	1	0
8 There is an improved quality of education	5	4	3	2	1	0
9 Income is more regular	5	4	3	2	1	0
10 Income is sufficient for household needs	5	4	3	2	1	0
11 There are enough jobs available now	5	4	3	2	1	0
12 There is enough training on possible livelihood	5	4	3	2	1	0
13 There is enough training on new farming practices	5	4	3	2	1	0
14 There is enough food for the family	5	4	3	2	1	0
15 It is now easy to take a public transportation	5	4	3	2	1	0
16 There is general feeling of satisfaction in the community.	5	4	3	2	1	0
17 I am contented with the way our needs are met.	5	4	3	2	1	0
18 Our living conditions now are much better than 5 years ago	5	4	3	2	1	0

APPENDIX 2: SELF ASSESSMENT OF RURAL DEVELOPMENT STATUS

The following is the scale used in collecting perceptions on rural development status in rural areas:

Please indicate your agreement on the following issues on rural development and poverty.
0 – Not Applicable 1 - Disagree 5 - Agree (1,2 levels of disagreement, 4,5 levels of agreement, 3 about to agree/disagree)
(The showcard will contain 5 varying faces indicating extent of agreement/disagreement to the statement.)

1 The poverty reduction strategy of the government is effective.	5	4	3	2	1	0
2. There is rural development	5	4	3	2	1	0
3. There are enough programs by local government on agriculture.	5	4	3	2	1	0
4. There are enough employment opportunities.	5	4	3	2	1	0
5. There is equitable access to productive resources.	5	4	3	2	1	0
6. Harvesting of resources is sustainable.	5	4	3	2	1	0
7. There are enough agricultural trainings.	5	4	3	2	1	0
8. The rural sector participates in the discussion on development issues.	5	4	3	2	1	0
9. Government's effort on agricultural research is important.	5	4	3	2	1	0
10. There is enough employment/livelihood in the area.	5	4	3	2	1	0
11. Agrarian reform is properly implemented.	5	4	3	2	1	0
12. The state of environment may cause calamities.	5	4	3	2	1	0
13. Ecological integrity can be maintained while there is development.	5	4	3	2	1	0

APPENDIX 3: PERCEPTION OF HOUSEHOLDS ON RURAL INFRASTRUCTURE AND OTHER INTERVENTIONS

Rural Infrastructure/Other Interventions	Available (%)	Accessed (%)	Needed (%)	Satisfied (%)	Effective (5)
Dist. Of High Quality Hybrid Seeds/Planting Materials	47	24	44	21	21
Construction/Rehabilitation of Irrigation	36	21	34	19	18
Fertilizer Support	43	24	41	22	22
Provision of Farm Tools and Machines	24	14	23	13	13
Provision of Dryers	27	17	26	16	15
Provision of Warehouses	13	6	12	6	6
Provision of Millers	19	12	19	11	11
Provision of Haulers	12	7	12	6	6
Provision/Rehabilitation of Rural Roads	49	42	48	39	38
Provision/Rehabilitation of Bridges	33	28	33	26	26
Training on Pest Management	33	19	31	18	17
Training on Planting Technologies	31	17	29	16	15
Training on Use of Farm Machineries	20	10	19	9	9
Training on Harvesting Methods/Equipments	19	9	18	8	8
Training on Use of Hybrid Varieties	25	13	24	12	12
Training on Multiple Cropping	19	10	18	9	9
Training on Crop Selection	19	10	18	9	9
Training on In-Farm Livelihood Activities	31	15	30	13	13
Training on Off-Farm Livelihood Activities	25	11	25	10	10
Training on Microenterprise Development	11	4	11	4	4
Training on Organizational/Cooperative Management	18	9	18	8	8
Provision of Microcredit for Agricultural Production	17	6	17	6	6
Provision of Microcredit for Livelihood or Microenterprise Development	15	5	14	4	4
Support in Organizing Commodity Volume Accumulation Center	11	7	12	7	6
Support in Market Linkages	11	7	12	7	6
Support in Market Information	9	6	10	5	5
Land Distribution or Other Tenurial Instruments	13	6	13	6	6
Development of Cooperatives	30	15	29	13	13
Training of Cooperative Members	27	13	26	12	4
Training and Information on Care and Management of Environment	21	14	21	13	13
Training and Information on Community-Based Management of Resources	9	5	9	5	12
Construction of Health Centers	85	78	83	73	72
Establishing Demonstration Farms	17	11	16	10	10
Establishing Community Plant Nursery	16	10	15	9	9

Source of Basic Data: (NEDA-WB-ASEM, 2005)

APPENDIX 4: LOGISTIC REGRESSION OF “THERE IS RURAL DEVELOPMENT” RESULTS

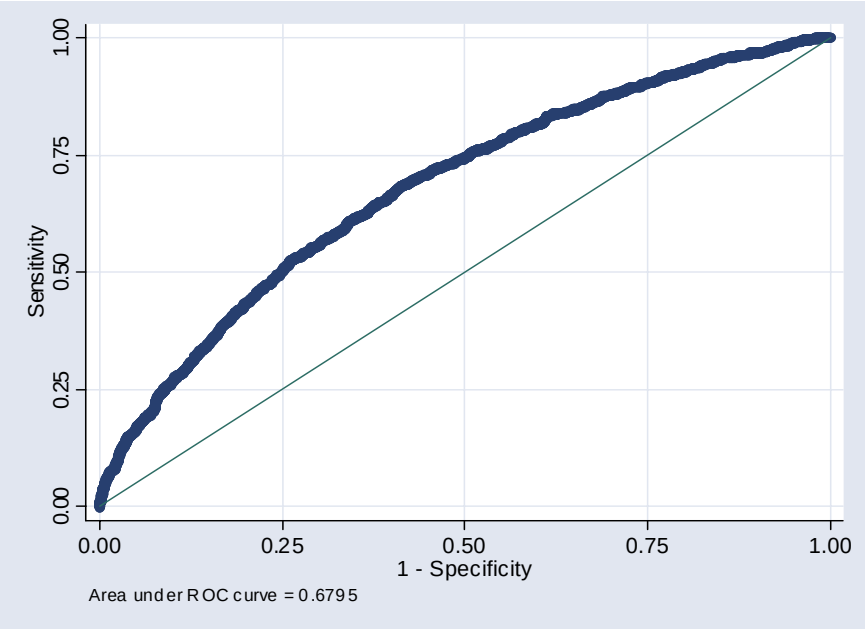
Logistic regression — Number of obs = 4358; LR chi2(52) = 438.78; Prob > chi2 = 0.0000; Log likelihood = -2732.9624; Pseudo R2 = 0.0743

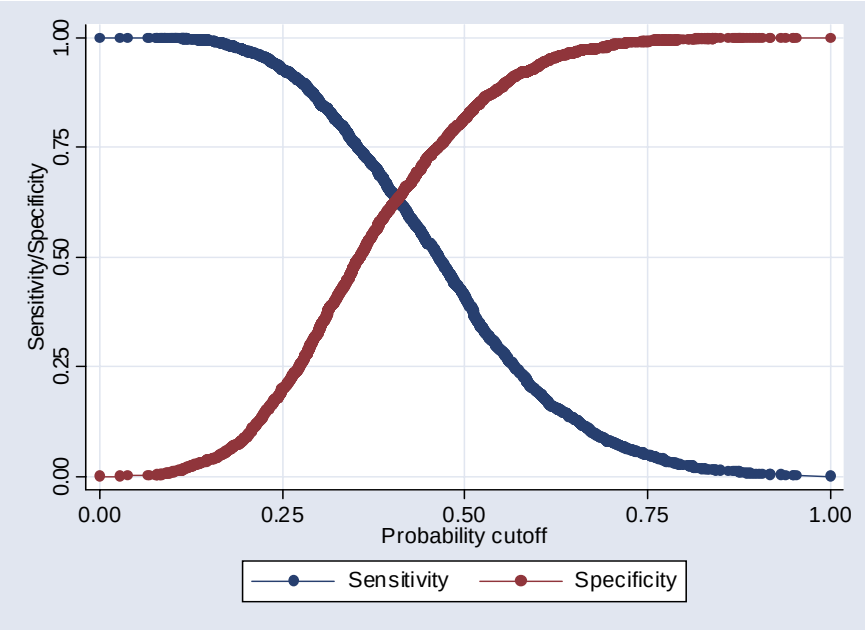
ruraldev	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
farminc	1	1.60e-07	1.82	0.069	1	1.000001
i3_fpi4	3.163559	1.492136	2.44	0.015	1.255148	7.973645
wrrdi	1.065114	.0071235	9.43	0.000	1.051243	1.079167
irrigorg	1.909693	.4501926	2.74	0.006	1.203097	3.031283
creditgov	1.291312	.1197783	2.76	0.006	1.076655	1.548768
i116	1.123297	.0726055	1.80	0.072	.9896374	1.275007
i28	1.016166	.0092403	1.76	0.078	.9982155	1.034439
roadmain	1.310909	.0949417	3.74	0.000	1.13743	1.510846
i2_os6	.4362954	.1518551	-2.38	0.017	.2205541	.8630702
i226	.9610319	.0131089	-2.91	0.004	.9356793	.9870714
nonfarm	.8500813	.0680661	-2.03	0.043	.7266155	.9945264
i120	.8682375	.0699511	-1.75	0.079	.7414126	1.016757
b2	.7966301	.0755803	-2.40	0.017	.661453	.9594326
creditrepay	1.226617	.1205592	2.08	0.038	1.01169	1.487202
islam	.4438237	.1480826	-2.43	0.015	.2307839	.8535233
i122	.8539275	.0625183	-2.16	0.031	.7397795	.9856887
agri	1.01089	.0030523	3.59	0.000	1.004926	1.016891
i3_tl4	.2033523	.1144694	-2.83	0.005	.067468	.6129153
comorg	1.254599	.104359	2.73	0.006	1.065862	1.476757
sch0_6	1.002741	.0014079	1.95	0.051	.9999858	1.005505
elec	1.558758	.320787	2.16	0.031	1.041368	2.333205
i3_tft4	2.445561	1.227881	1.78	0.075	.9141188	6.542663
industrial	.6468141	.1707867	-1.65	0.099	.3855012	1.085258
admin	1.010613	.005281	2.02	0.043	1.000315	1.021016
workover21	1.001325	.0007594	1.75	0.081	.9998377	1.002814
i2_tft2	.4278258	.133554	-2.72	0.007	.2320322	.7888342
intmigr	1.190738	.1148219	1.81	0.070	.9856794	1.438457
i3_ph4	3.577975	1.975725	2.31	0.021	1.212305	10.55998
i129	.8992393	.0439573	-2.17	0.030	.817083	.9896563
i219	.9811295	.0064455	-2.90	0.004	.9685775	.9938441
wall	1.377907	.0923353	4.78	0.000	1.208314	1.571303
i2_ph6	1.814736	.5202446	2.08	0.038	1.034649	3.182981
b4	1.379037	.1876148	2.36	0.018	1.056263	1.800445
toilet	1.174363	.1129843	1.67	0.095	.9725437	1.418063
farmerorg	1.292484	.1583249	2.09	0.036	1.016613	1.643215
i213	.9814991	.0084081	-2.18	0.029	.9651572	.9981178
cough	.7643874	.0751443	-2.73	0.006	.6304271	.9268132
i220	1.019887	.010007	2.01	0.045	1.000461	1.039691
i2_tl2	1.960047	.5234315	2.52	0.012	1.161322	3.308113
i3_ph2	.2361707	.1431443	-2.38	0.017	.071996	.774718
i212	1.017883	.0068898	2.62	0.009	1.004469	1.031477
i2_tft3	2.87984	.8721652	3.49	0.000	1.590671	5.213825
amortizing	1.924319	.7137166	1.76	0.078	.930191	3.980905
mccoopav	1.271442	.0942378	3.24	0.001	1.099529	1.470235
i3_lti1	2.628159	1.213251	2.09	0.036	1.063425	6.495258
br4	.5108491	.1002474	-3.42	0.001	.3477408	.7504637
br6	1.78772	.3666176	2.83	0.005	1.196022	2.672146
i225	1.023768	.0124281	1.93	0.053	.9996968	1.048419
prof	1.006336	.0029579	2.15	0.032	1.000555	1.01215
inheritten~y	.567223	.1748489	-1.84	0.066	.310004	1.037864
i124	1.171543	.0669374	2.77	0.006	1.047427	1.310366
prvhosp	.8294237	.0831877	-1.86	0.062	.6814038	1.009598

Logistic model for ruraldev, goodness-of-fit test

```
      number of observations =      4358
 number of covariate patterns =      4184
           Pearson chi2(4131) =      4213.70
                 Prob > chi2 =         0.1811


Logistic model for ruraldev
              -------- True --------
Classified |         D            ~D  |      Total
-----------+--------------------------+-----------
     +     |       732           473  |       1205
     -     |      1062          2091  |       3153
-----------+--------------------------+-----------
   Total   |      1794          2564  |       4358
Classified + if predicted Pr(D) >= .5
True D defined as ruraldev != 0
--------------------------------------------------
Sensitivity                     Pr( +| D)   40.80%
Specificity                     Pr( -|~D)   81.55%
Positive predictive value       Pr( D| +)   60.75%
Negative predictive value       Pr(~D| -)   66.32%
--------------------------------------------------
False + rate for true ~D        Pr( +|~D)   18.45%
False - rate for true D         Pr( -| D)   59.20%
False + rate for classified +   Pr(~D| +)   39.25%
False - rate for classified -   Pr( D| -)   33.68%
--------------------------------------------------
Correctly classified                        64.78%
--------------------------------------------------
```





Logit estimates

Number of obs	= 4358
LR chi2(52)	= 438.78
Prob > chi2	= 0.0000
Log likelihood = -2732.9624	Pseudo R2 = 0.0743

ruraldev	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
farminc	2.91e-07	1.60e-07	1.82	0.069	-2.24e-08	6.05e-07
i3_fpi4	1.151698	.4716638	2.44	0.015	.2272536	2.076142
wrrdi	.0630814	.006688	9.43	0.000	.0499731	.0761897
irrigorg	.6469423	.2357409	2.74	0.006	.1848987	1.108986
creditgov	.2556591	.0927571	2.76	0.006	.0738586	.4374596
i116	.1162677	.064636	1.80	0.072	-.0104166	.242952
i28	.0160365	.0090933	1.76	0.078	-.0017861	.033859
roadmain	.2707205	.0724243	3.74	0.000	.1287714	.4126696
i2_os6	-.8294358	.3480556	-2.38	0.017	-1.511612	-.1472593
i226	-.0397477	.0136404	-2.91	0.004	-.0664825	-.0130129
nonfarm	-.1624233	.0800701	-2.03	0.043	-.3193579	-.0054887
i120	-.14129	.0805668	-1.75	0.079	-.299198	.0166179
b2	-.2273648	.094875	-2.40	0.017	-.4133163	-.0414132
creditrepay	.2042596	.098286	2.08	0.038	.0116226	.3968966
islam	-.8123279	.3336518	-2.43	0.015	-1.466273	-.1583824
i122	-.1579089	.0732127	-2.16	0.031	-.3014031	-.0144147
agri	.0108315	.0030194	3.59	0.000	.0049136	.0167495
i3_tl4	-1.592815	.5629117	-2.83	0.005	-2.696102	-.4895286
comorg	.2268162	.0831811	2.73	0.006	.0637841	.3898482
sch0_6	.0027376	.001404	1.95	0.051	-.0000142	.0054895
elec	.4438891	.2057966	2.16	0.031	.0405352	.847243
i3_tft4	.8942747	.5020855	1.78	0.075	-.0897947	1.878344
industrial	-.4356964	.2640429	-1.65	0.099	-.953211	.0818182
admin	.0105567	.0052256	2.02	0.043	.0003148	.0207986
workover21	.0013241	.0007584	1.75	0.081	-.0001623	.0028105
i2_tft2	-.8490391	.312169	-2.72	0.007	-1.460879	-.2371991
intmigr	.1745736	.0964292	1.81	0.070	-.0144241	.3635713
i3_ph4	1.274797	.5521907	2.31	0.021	.1925232	2.357071
i129	-.1062061	.0488828	-2.17	0.030	-.2020146	-.0103976
i219	-.0190508	.0065695	-2.90	0.004	-.0319268	-.0061749
wall	.3205655	.0670113	4.78	0.000	.1892258	.4519052
i2_ph6	.59594	.2866778	2.08	0.038	.0340618	1.157818
b4	.3213856	.1360476	2.36	0.018	.0547371	.588034
toilet	.1607259	.096209	1.67	0.095	-.0278403	.3492921
farmerorg	.2565657	.1224966	2.09	0.036	.0164767	.4966547
i213	-.0186742	.0085666	-2.18	0.029	-.0354643	-.001884
cough	-.2686805	.0983065	-2.73	0.006	-.4613578	-.0760033

i220	.0196922	.0098119	2.01	0.045	.0004612	.0389231
i2_tl2	.6729685	.2670505	2.52	0.012	.1495593	1.196378
i3_ph2	-1.443201	.6061052	-2.38	0.017	-2.631145	-.2552562
i212	.0177254	.0067687	2.62	0.009	.0044589	.0309918
i2_tft3	1.057735	.302852	3.49	0.000	.4641557	1.651314
amortizing	.6545719	.3708932	1.76	0.078	-.0723653	1.381509
mccoopav	.240152	.0741188	3.24	0.001	.0948819	.3854222
i3_lti1	.9662835	.4616355	2.09	0.036	.0614947	1.871072
br4	-.671681	.1962368	-3.42	0.001	-1.056298	-.287064
br6	.5809413	.2050755	2.83	0.005	.1790007	.9828818
i225	.0234899	.0121396	1.93	0.053	-.0003033	.0472831
prof	.0063159	.0029392	2.15	0.032	.0005551	.0120767
inheritten~y	-.5670028	.3082542	-1.84	0.066	-1.17117	.0371644
i124	.1583216	.0571361	2.77	0.006	.0463369	.2703063
prvhosp	-.1870241	.1002958	-1.86	0.062	-.3836002	.009552
_cons	-5.406378	.4511043	-11.98	0.000	-6.290526	-4.52223

APPENDIX 5: SPATIAL ADDITIVE FOR RDI RESULTS

```
      Source |       SS       df       MS              Number of obs =    5326
-------------+------------------------------           F(  7,  5318) =   73.54
       Model |  202663.971     7  28951.9959           Prob > F      =  0.0000
    Residual |  2093701.13  5318  393.700852           R-squared     =  0.0883
-------------+------------------------------           Adj R-squared =  0.0871
       Total |   2296365.1  5325  431.242273           Root MSE      =  19.842

------------------------------------------------------------------------------
         rdi |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     farminc |   2.42e-06   9.96e-07     2.43   0.015     4.67e-07    4.37e-06
    roadmain |   2.000226   .6927994     2.89   0.004     .6420547    3.358396
       wrrdi |  -2.797715   1.700229    -1.65   0.100     -6.13086     .535431
       wsrdi |   -2.97547   1.713636    -1.74   0.083    -6.334899    .3839588
          w1 |   .0667817   .0310345     2.15   0.031     .0059414    .1276219
     irrmain |   1.388528   .6975741     1.99   0.047     .0209971     2.75606
      phmain |    2.94377   .7279947     4.04   0.000     1.516602    4.370938
       _cons |   167.5357   93.84975     1.79   0.074    -16.44831    351.5197
------------------------------------------------------------------------------

      Source |       SS       df       MS              Number of obs =    5326
-------------+------------------------------           F(  6,  5319) =    5.72
       Model |  13415.3942     6  2235.89904           Prob > F      =  0.0000
    Residual |  2080285.74  5319   391.10467           R-squared     =  0.0064
-------------+------------------------------           Adj R-squared =  0.0053
       Total |  2093701.14  5325  393.183312           Root MSE      =  19.776

------------------------------------------------------------------------------
        rdi1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     sch6_12 |   .0172174   .0064104     2.69   0.007     .0046504    .0297844
    sch17_21 |   .0136378   .0077343     1.76   0.078    -.0015247    .0288003
    depend12 |  -.0260411   .0123641    -2.11   0.035    -.0502797   -.0018024
     notmigr |   1.301375   .5771753     2.25   0.024     .1698751    2.432876
     intmigr |   1.470534   .7743534     1.90   0.058    -.0475162    2.988584
  workover21 |   .0184567   .0061059     3.02   0.003     .0064867    .0304268
       _cons |  -3.138566   .8995905    -3.49   0.000    -4.902132      -1.375
------------------------------------------------------------------------------

      Source |       SS       df       MS              Number of obs =    5326
-------------+------------------------------           F(  3,  5322) =   12.33
       Model |  14360.3731     3  4786.79104           Prob > F      =  0.0000
    Residual |  2065925.37  5322  388.185901           R-squared     =  0.0069
-------------+------------------------------           Adj R-squared =  0.0063
       Total |  2080285.74  5325  390.663988           Root MSE      =  19.702

------------------------------------------------------------------------------
        rdi2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        roof |   1.424448   .5586398     2.55   0.011     .3292848    2.519611
    govthosp |  -1.554159   .6968348    -2.23   0.026     -2.92024    -.188077
      toilet |   2.997115   .7023592     4.27   0.000     1.620203    4.374027
       _cons |  -2.911548   .6505384    -4.48   0.000     -4.18687   -1.636226
------------------------------------------------------------------------------

      Source |       SS       df       MS              Number of obs =    4392
-------------+------------------------------           F(  2,  4389) =    9.06
       Model |  7015.12691     2  3507.56346           Prob > F      =  0.0001
    Residual |  1700094.22  4389  387.353434           R-squared     =  0.0041
-------------+------------------------------           Adj R-squared =  0.0037
       Total |  1707109.35  4391  388.774618           Root MSE      =  19.681

------------------------------------------------------------------------------
        rdi3 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      comorg |   2.549524   .7632132     3.34   0.001     1.053241    4.045807
    irrigorg |   5.539626   2.119422     2.61   0.009      1.38449    9.694763
       _cons |  -.7497969   .3317722    -2.26   0.024    -1.400238    -.099356
------------------------------------------------------------------------------

      Source |       SS       df       MS              Number of obs =    5326
-------------+------------------------------           F(  1,  5324) =    4.22
       Model |  1632.23049     1  1632.23049           Prob > F      =  0.0399
    Residual |  2058096.02  5324    386.5695           R-squared     =  0.0008
-------------+------------------------------           Adj R-squared =  0.0006
       Total |  2059728.25  5325  386.803427           Root MSE      =  19.661
```

```
------------------------------------------------------------------------------
        rdi4 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        agri |   .0490255   .0238586     2.05   0.040     .0022529    .0957982
       _cons |   .0049955   .2834337     0.02   0.986    -.5506506    .5606415
------------------------------------------------------------------------------

      Source |       SS       df       MS              Number of obs =    5326
-------------+------------------------------           F(  4,  5321) =    7.95
       Model |  12233.1112     4   3058.2778           Prob > F      =  0.0000
    Residual |  2045862.95  5321  384.488433           R-squared     =  0.0059
-------------+------------------------------           Adj R-squared =  0.0052
       Total |  2058096.06  5325  386.496914           Root MSE      =  19.608

------------------------------------------------------------------------------
        rdi5 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      tenant |    3.37592   .7869787     4.29   0.000     1.833119    4.918721
         own |   1.254455   .6166544     2.03   0.042       .04556    2.463351
  amortizing |    8.36614   3.164095     2.64   0.008     2.163217    14.56906
     upland |   .4630886   .2330683     1.99   0.047     .0061791     .919998
       _cons |    -1.1546   .3795538    -3.04   0.002    -1.898681   -.4105192
------------------------------------------------------------------------------

      Source |       SS       df       MS              Number of obs =    5326
-------------+------------------------------           F(  7,  5318) =   11.04
       Model |  29315.1102     7  4187.87289           Prob > F      =  0.0000
    Residual |  2016547.81  5318  379.192893           R-squared     =  0.0143
-------------+------------------------------           Adj R-squared =  0.0130
       Total |  2045862.92  5325  384.199609           Root MSE      =  19.473

------------------------------------------------------------------------------
        rdi6 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 creditrepay |   2.752348   .6181064     4.45   0.000     1.540606     3.96409
    mccoopac |    2.33913   .9137023     2.56   0.010     .5478985    4.130361
   mcgbankav |   2.256361   .9822183     2.30   0.022     .3308107    4.181912
     phfacil |   5.193719   2.741423     1.89   0.058    -.1805951    10.56803
     mcgfiav |   9.061952   1.892495     4.79   0.000     5.351885    12.77202
     mcgfiac |  -13.05389   3.302386    -3.95   0.000    -19.52792   -6.579856
    prodloan |   -2.47991   1.151964    -2.15   0.031    -4.738232   -.2215878
       _cons |  -2.587589   .5515059    -4.69   0.000    -3.668766   -1.506411
------------------------------------------------------------------------------

      Source |       SS       df       MS              Number of obs =    5283
-------------+------------------------------           F( 33,  5249) =    4.30
       Model |  52592.8721    33   1593.7234           Prob > F      =  0.0000
    Residual |  1943795.47  5249  370.317292           R-squared     =  0.0263
-------------+------------------------------           Adj R-squared =  0.0202
       Total |  1996388.34  5282  377.960685           Root MSE      =  19.244

------------------------------------------------------------------------------
        rdi7 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     areaadj |   1.713528   .4512627     3.80   0.000     .8288658    2.598191
        i21 |   .0832391   .0452058     1.84   0.066     -.005383    .1718613
      ageadj |  -.0482329   .0271912    -1.77   0.076    -.1015389    .0050732
     ageadj2 |   .0022403   .0011392     1.97   0.049     6.93e-06    .0044737
     i2_fpi1 |  -2.480024   1.353856    -1.83   0.067    -5.134145    .1740961
        i126 |    2.25432   .7517844     3.00   0.003     .7805097     3.72813
        i123 |   1.648263   .8724714     1.89   0.059    -.0621438     3.35867
        i212 |  -.0877862   .0502697    -1.75   0.081    -.1863356    .0107633
     i3_fpi4 |    11.1933   4.348552     2.57   0.010     2.668333    19.71827
     i3_fpi6 |  -8.495248    4.7443    -1.79   0.073    -17.79605    .8055538
      i2_ph3 |   4.967488   2.161574     2.30   0.022     .7299047    9.205072
        i132 |  -1.623938    .456063    -3.56   0.000    -2.518011    -.729865
         br6 |   4.117373   1.859797     2.21   0.027     .4713968    7.763349
        i121 |  -1.172574   .4888251    -2.40   0.016    -2.130875   -.2142737
        i125 |   -1.77297    .627896    -2.82   0.005    -3.003907   -.5420328
     i2_tft3 |  -7.709473   2.273298    -3.39   0.001    -12.16608   -3.252865
     i2_tft4 |   4.960242    2.72763     1.82   0.069    -.3870474    10.30753
          b3 |  -4.440714   1.413989    -3.14   0.002    -7.212721   -1.668707
        i112 |  -1.159336   .4563647    -2.54   0.011    -2.054001   -.2646719
     i2_tft7 |   4.839006   2.299451     2.10   0.035     .3311265    9.346886
        i116 |   .8387854   .4968378     1.69   0.091    -.1352233    1.812794
        i131 |   1.115049   .6457493     1.73   0.084     -.150888    2.380986
        i221 |   .2124763   .0612028     3.47   0.001     .0924934    .3324592
```

```
        i114 |  -1.909885    .563299    -3.39   0.001    -3.014186    -.805585
        i229 |   .0881832   .0525178     1.68   0.093    -.0147736      .19114
          b4 |   2.553285   1.443797     1.77   0.077    -.2771583    5.383729
     i3_ocb1 |  -6.879749   3.507305    -1.96   0.050    -13.75552   -.0039725
         i23 |  -.0907933   .0456153    -1.99   0.047    -.1802182   -.0013683
        i231 |  -.1922895    .072802    -2.64   0.008    -.3350116   -.0495673
          b5 |  -3.328982   1.953244    -1.70   0.088    -7.158152    .5001878
      i3_ph4 |  -7.398437   3.688918    -2.01   0.045    -14.63025    -.166624
        i115 |   1.338683   .5179082     2.58   0.010     .3233676    2.353999
     i3_lti1 |   8.596055      3.306     2.60   0.009     2.114919    15.07719
       _cons |  -.2279601   .3660384    -0.62   0.533    -.9455476    .4896273
------------------------------------------------------------------------------

. predict rdierr, resid
(43 missing values generated)

. gen aperdiadd=abs(rdierr)
(43 missing values generated)

. sum aperdiadd, detail

                          aperdiadd
-------------------------------------------------------------
      Percentiles      Smallest
 1%     .1808723       .0005737
 5%     1.048358       .0033927
10%     2.009198       .0047022       Obs                5283
25%     4.900703       .0058451       Sum of Wgt.        5283

50%     10.17546                      Mean           14.01554
                        Largest       Std. Dev.      13.09699
75%     18.64712       69.82649
90%     30.07888       69.87405       Variance       171.5311
95%     45.30962       70.77287       Skewness       1.732325
99%     60.13055       71.48418       Kurtosis       6.048047
```

APPENDIX 6: SPATIAL ADDITIVE MODEL FOR FARM INCOME RESULTS

```
      Source |       SS       df       MS              Number of obs =    5326
-------------+------------------------------           F(  7,  5318) =   79.41
       Model |  12691.2383     7  1813.03404            Prob > F      =  0.0000
    Residual |  121423.157  5318  22.8324853            R-squared     =  0.0946
-------------+------------------------------           Adj R-squared =  0.0934
       Total |  134114.395  5325  25.1858019            Root MSE      =  4.7783

------------------------------------------------------------------------------
    lfarminc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      wrfarm |   9.31e-06   1.84e-06     5.06   0.000     5.70e-06    .0000129
   farmerorg |   2.056803   .2461888     8.35   0.000     1.574172    2.539434
     cooporg |     .48237   .1997994     2.41   0.016     .0906812    .8740588
     irrmain |   1.034425   .1653308     6.26   0.000     .7103091    1.358541
      phmain |   1.677004   .1644165    10.20   0.000      1.35468    1.999328
    irrigorg |   2.365613   .4935181     4.79   0.000     1.398115    3.333111
   creditorg |   1.319596    .346657     3.81   0.000     .6400066    1.999186
       _cons |   2.424669   .1451744    16.70   0.000     2.140068     2.70927
------------------------------------------------------------------------------


      Source |       SS       df       MS              Number of obs =    5326
-------------+------------------------------           F(  4,  5321) =   14.02
       Model |   1266.2845     4  316.571125            Prob > F      =  0.0000
    Residual |  120156.872  5321  22.5816336            R-squared     =  0.0104
-------------+------------------------------           Adj R-squared =  0.0097
       Total |  121423.157  5325  22.8024708            Root MSE      =   4.752

------------------------------------------------------------------------------
         lf1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          hs |  -.5451271   .1478216    -3.69   0.000     -.834918   -.2553363
     college |  -.5863684   .1721378    -3.41   0.001    -.9238291   -.2489076
  nuclearfam |   .2562293   .1466451     1.75   0.081    -.0312552    .5437138
  workover21 |   -.008552    .001453    -5.89   0.000    -.0114005   -.0057035
       _cons |   .4886389    .154825     3.16   0.002     .1851185    .7921593
------------------------------------------------------------------------------

      Source |       SS       df       MS              Number of obs =    5326
-------------+------------------------------           F( 18,  5307) =  134.18
       Model |  37580.7445    18  2087.81914            Prob > F      =  0.0000
    Residual |  82576.1278  5307  15.5598507            R-squared     =  0.3128
-------------+------------------------------           Adj R-squared =  0.3104
       Total |  120156.872  5325  22.5646709            Root MSE      =  3.9446

------------------------------------------------------------------------------
         lf2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        rice |   1.362836   .1575751     8.65   0.000     1.053924    1.671748
        corn |   1.154734   .2185612     5.28   0.000     .7262646    1.583204
     coconut |   3.523113   .2038196    17.29   0.000     3.123542    3.922683
  amortizing |   1.170141   .6485395     1.80   0.071    -.1012633    2.441545
  industrial |   2.885491   .4324953     6.67   0.000     2.037623     3.73336
   livestock |   3.064782    .233366    13.13   0.000     2.607289    3.522276
inheritten~y |   1.787529   .4960865     3.60   0.000     .8149959    2.760063
        cash |   .9379582   .1906504     4.92   0.000     .5642051    1.311711
      tenant |   2.344184   .2062378    11.37   0.000     1.939873    2.748494
     riceint |   .0004329   .0002395     1.81   0.071    -.0000366    .0009024
     cornint |   .2391876   .0737612     3.24   0.001     .0945852    .3837899
  lowirrarea |   .3770942   .0712243     5.29   0.000     .2374652    .5167232
  lownonarea |   .0538082   .0242698     2.22   0.027     .0062294     .101387
      upland |   .1664961   .0491404     3.39   0.001     .0701607    .2628315
     pasture |   .4875872   .2911907     1.67   0.094    -.0832663    1.058441
         own |   2.453647   .1752489    14.00   0.000     2.110087    2.797207
      leased |   3.536133   .4005222     8.83   0.000     2.750945    4.321321
    mortgage |   2.919444    .575653     5.07   0.000     1.790928     4.04796
       _cons |  -2.806318   .0814157   -34.47   0.000    -2.965926   -2.646709
------------------------------------------------------------------------------

      Source |       SS       df       MS              Number of obs =    5326
-------------+------------------------------           F(  6,  5319) =    7.15
       Model |  660.590634     6  110.098439            Prob > F      =  0.0000
    Residual |  81915.5366  5319  15.4005521            R-squared     =  0.0080
-------------+------------------------------           Adj R-squared =  0.0069
       Total |  82576.1272  5325  15.5072539            Root MSE      =  3.9244
```

```
------------------------------------------------------------------------------
         lf3 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    prodloan |   .5357472   .2328978     2.30   0.021     .0791721    .9923223
    mccoopac |  -.3937065   .1883841    -2.09   0.037    -.7630167   -.0243964
     homefin |  -.6443944   .1765078    -3.65   0.000     -.990422   -.2983668
     phfacil |   1.179652   .5528514     2.13   0.033     .0958368    2.263468
     mcgfiav |   .9106685   .3005929     3.03   0.002     .3213831    1.499954
     farmimp |   .4428051   .1989939     2.23   0.026     .0526955    .8329147
       _cons |  -.0031789   .0636142    -0.05   0.960    -.1278887     .121531
------------------------------------------------------------------------------

      Source |       SS       df       MS              Number of obs =    5283
-------------+------------------------------           F( 20,  5262) =    5.88
       Model |  1779.66068    20  88.9830342           Prob > F      =  0.0000
    Residual |  79610.9188  5262   15.129403           R-squared     =  0.0219
-------------+------------------------------           Adj R-squared =  0.0181
       Total |  81390.5795  5282  15.4090457           Root MSE      =  3.8897

------------------------------------------------------------------------------
         lf4 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     areaadj |  -.0543301   .0226059    -2.40   0.016    -.0986471   -.0100131
        i130 |   .1953823   .0948572     2.06   0.039     .0094227    .3813418
      ageadj |  -.0119675   .0038423    -3.11   0.002       -.0195   -.0044351
        i12 |   .1758237   .0673658     2.61   0.009     .0437588    .3078887
     i2_fpi1 |   .7372256   .2831242     2.60   0.009     .1821847    1.292266
     i2_fpi3 |  -.8468514   .3510844    -2.41   0.016    -1.535123   -.1585804
         br2 |  -.3028512   .1766985    -1.71   0.087    -.6492537    .0435513
        i120 |  -.3116621   .1312695    -2.37   0.018    -.5690047   -.0543194
        i114 |   .3781926   .1053129     3.59   0.000     .1717357    .5846495
        i133 |  -.3281229   .1082097    -3.03   0.002    -.5402589    -.115987
      i2_ph3 |   1.098663   .4328236     2.54   0.011     .2501494    1.947177
     i3_ocb1 |   1.086488   .6203349     1.75   0.080    -.1296253    2.302602
        i121 |   .3528756    .108392     3.26   0.001     .1403824    .5653688
     i3_tft6 |  -1.738982   .5671848    -3.07   0.002    -2.850899   -.6270641
        i118 |   .1508653   .0838389     1.80   0.072    -.0134936    .3152243
        i126 |  -.2781655   .1271717    -2.19   0.029    -.5274747   -.0288562
        i134 |   .2514829   .1084677     2.32   0.020     .0388411    .4641246
        i112 |  -.2621128   .0789337    -3.32   0.001    -.4168557   -.1073699
         i17 |   .4126705   .1100435     3.75   0.000     .1969395    .6284015
     i2_ocb2 |  -.7440646   .3764408    -1.98   0.048    -1.482045   -.0060845
       _cons |   .0645903   .0582138     1.11   0.267    -.0495329    .1787134
------------------------------------------------------------------------------
                        apefarmadd
-------------------------------------------------------------
      Percentiles      Smallest
 1%      .723089       .0672074
 5%      3.245842       .148299
10%      6.197344       .1622212       Obs                2416
25%      15.58593       .1630482       Sum of Wgt.        2416

50%      29.43713                      Mean           33.19672
                        Largest       Std. Dev.      22.82155
75%      46.29243       107.6966
90%       65.1321        107.734       Variance       520.8233
95%      77.36747       107.9066       Skewness       .8068743
99%      97.09464        108.409       Kurtosis       3.235003

. drop apefarmadd
. gen apefarmadd=(100*exp(abs(lferr)))/farminc
(2910 missing values generated)

. sum apefarmadd, detail
                        apefarmadd
-------------------------------------------------------------
      Percentiles      Smallest
 1%     .0012586        .000015
 5%     .0040729       .0001955
10%     .0084841       .0002516       Obs                2416
25%      .027488        .000271       Sum of Wgt.        2416

50%      .104981                      Mean           3.324435
                        Largest       Std. Dev.      16.35675
75%     .5589297       199.1093
90%     3.351768       226.3076       Variance       267.5432
95%     11.67186       235.6032       Skewness        8.86184
99%     72.14625       242.6177       Kurtosis       97.42754
```

APPENDIX 7: SPATIAL ADDITIVE MODEL FOR NONFARM INCOME RESULTS

```
      Source |       SS       df       MS              Number of obs =    3808
-------------+------------------------------           F(  3,  3804) =   78.90
       Model |  207.852799     3  69.2842662           Prob > F      =  0.0000
    Residual |   3340.5148  3804  .878158464           R-squared     =  0.0586
-------------+------------------------------           Adj R-squared =  0.0578
       Total |   3548.3676  3807  .932063987           Root MSE      =   .9371
------------------------------------------------------------------------------
 lnonfarminc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   wrnonfarm |   7.31e-06   5.60e-07    13.06   0.000     6.21e-06    8.41e-06
   wsnonfarm |   6.34e-06   8.32e-07     7.62   0.000     4.71e-06    7.97e-06
     cooporg |   .0835438   .0472579     1.77   0.077    -.0091093     .176197
       _cons |   9.633375    .109615    87.88   0.000     9.418465    9.848285
------------------------------------------------------------------------------
      Source |       SS       df       MS              Number of obs =    3808
-------------+------------------------------           F( 11,  3796) =   56.72
       Model |  471.550391    11  42.8682173           Prob > F      =  0.0000
    Residual |  2868.96442  3796  .755786202           R-squared     =  0.1412
-------------+------------------------------           Adj R-squared =  0.1387
       Total |  3340.51481  3807   .87746646           Root MSE      =  .86936

------------------------------------------------------------------------------
        lnf1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     college |    .339692   .0344922     9.85   0.000      .272067    .4073171
  nuclearfam |   -.102876   .0317016    -3.25   0.001    -.1650299   -.0407222
      hhsize |   .0512437   .0056758     9.03   0.000     .0401158    .0623715
   work17_21 |   .0017759     .00061     2.91   0.004     .0005799    .0029719
  workover21 |    .000656   .0003184     2.06   0.039     .0000317    .0012803
      empfff |  -.1348592   .0334835    -4.03   0.000    -.2005066   -.0692118
      empent |  -.1058995   .0376904    -2.81   0.005     -.179795    -.032004
      empofw |   1.028642   .4364424     2.36   0.018     .1729582    1.884327
        prof |   .0052847    .001277     4.14   0.000      .002781    .0077883
       admin |  -.0201065   .0019484   -10.32   0.000    -.0239266   -.0162865
    fulltime |   .0106979   .0007561    14.15   0.000     .0092154    .0121803
       _cons |  -.4669879   .0548333    -8.52   0.000    -.5744934   -.3594824
------------------------------------------------------------------------------

      Source |       SS       df       MS              Number of obs =    3808
-------------+------------------------------           F(  6,  3801) =    6.38
       Model |  28.6081527     6  4.76802544           Prob > F      =  0.0000
    Residual |  2840.35628  3801  .747265529           R-squared     =  0.0100
-------------+------------------------------           Adj R-squared =  0.0084
       Total |  2868.96443  3807  .753602424           Root MSE      =  .86445

------------------------------------------------------------------------------
        lnf2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    mccoopav |   .0954696   .0317418     3.01   0.003      .033237    .1577022
     farmimp |  -.2285592   .0606443    -3.77   0.000    -.3474578   -.1096606
   mcgbankav |   .0829429   .0461735     1.80   0.073    -.0075844    .1734702
 creditrepay |   .0748795   .0324781     2.31   0.021     .0112032    .1385557
    prodloan |  -.1231131   .0655043    -1.88   0.060    -.2515401    .0053139
    consloan |   .1549011   .0933371     1.66   0.097    -.0280944    .3378966
       _cons |  -.0764853   .0302456    -2.53   0.011    -.1357844   -.0171862
------------------------------------------------------------------------------

      Source |       SS       df       MS              Number of obs =    3784
-------------+------------------------------           F(  7,  3776) =    2.91
       Model |  15.1649468     7  2.16642098           Prob > F      =  0.0048
    Residual |  2807.14422  3776  .743417432           R-squared     =  0.0054
-------------+------------------------------           Adj R-squared =  0.0035
       Total |  2822.30917  3783  .746050534           Root MSE      =  .86222

------------------------------------------------------------------------------
        lnf3 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        i216 |  -.0086378    .004786    -1.80   0.071    -.0180211    .0007456
         br4 |  -.1371217   .0731037    -1.88   0.061    -.2804483     .006205
     i2_fpi1 |   .1635975   .0682911     2.40   0.017     .0297064    .2974885
          b3 |   .1327432   .0633864     2.09   0.036     .0084683    .2570181
     i3_tft5 |   .2734171   .1553872     1.76   0.079     -.031234    .5780681
      i3_mc1 |  -.2658072   .1485077    -1.79   0.074    -.5569702    .0253558
        i217 |   .0119813   .0047043     2.55   0.011      .002758    .0212046
```

```
       _cons |  -.0058404   .0145752    -0.40   0.689    -.0344165    .0227357
------------------------------------------------------------------------------


                          apenfarmadd
-------------------------------------------------------------
      Percentiles      Smallest
 1%     .0833014       .0001686
 5%     .4210005       .0027407
10%     .8500838       .0032561       Obs                3784
25%     2.129962       .0069774       Sum of Wgt.        3784

50%     4.569485                      Mean           6.034061
                        Largest       Std. Dev.      5.678497
75%     8.057197       44.97093
90%     12.84925        46.9798       Variance       32.24533
95%     16.50062       47.38177       Skewness       2.308739
99%      27.6897       49.23083       Kurtosis       11.45339

. drop apenfarmadd

. gen apenfarmadd=(100*exp(abs(lnferr)))/nonfarminc
(24 missing values generated)

. sum apenfarmadd, detail

                          apenfarmadd
-------------------------------------------------------------
      Percentiles      Smallest
 1%     .0005403       .0003016
 5%     .0007652       .0003576
10%     .0009316       .0003649       Obs                3784
25%     .0013556       .0003704       Sum of Wgt.        3784

50%     .0020768                      Mean           .0136241
                        Largest       Std. Dev.      .0945901
75%      .003983        1.46245
90%     .0131855        2.31804       Variance       .0089473
95%     .0303114       2.385149       Skewness       18.41596
99%     .2339839       2.733538       Kurtosis       425.3251
```