

**Draft for comments only**

# *Nepal Agriculture Public Expenditure Review*



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## Acronyms and Abbreviations

AgPER	Agricultural Public Expenditure Review
CBS	Central Bureau of Statistics
GoN	Government of Nepal
INSEC	Informal Sector Service Centre
MOA	Ministry of Agriculture and Co-operatives
MOF	Ministry of Finance
NLSS 1	Nepal Living Standards Survey 1
NLSS 2	Nepal Living Standards Survey 2
NPC	National Planning Commission
NPR	Nepali Rupees

## Table of Contents

Executive Summary	7
1 Introduction	8
2 Recent Developments in the Agricultural Sector	10
3 Trends and Composition of Agriculture, Rural Infrastructure, and Irrigation Public Expenditures	15
4 Analytical Framework	20
5 Agriculture Expenditure Returns	28
6 Rural Infrastructure Expenditure Returns	30
7 Irrigation Expenditure Returns	32
8 Conclusion	33
Bibliography	35
Appendix 1: Figures	36
Appendix 2: Tables	40

## List of Figures

Figure 1: *Effects of Government Expenditures on Rural Poverty Adapted from Fan et al. 2002*

Figure 2: *Trends in Total, Recurrent, and Capital Irrigation Expenditures, 1999-2003*

Figure 3: *Trends in Total, Recurrent, and Capital Agriculture Expenditures, 1999-2003*

Figure 4: *Trends in Total, Recurrent, and Capital Road Expenditures, 1999-2003*

## List of Tables

- Table 1: *Major Agricultural Growth Targets of the Ninth Plan (1997-2002)*
- Table 2: *Annual Growth Rates of GDP by ISIC Division, 1995/96 to 2004/05*
- Table 3: *Employment Sectors in Nepal, 1995-96 and 2003-04*
- Table 4: *Poverty in Nepal, 1995-96 and 2003-04 (percentages)*
- Table 5: *Poverty by Employment Sector of the Household Head in Nepal, 1995-96 and 2003-04*
- Table 6: *Poverty Measurement by Land Ownership in Nepal, 1995-96 and 2003-04 (Rural Areas Only)*
- Table 7: *Sources of Household Income in Nepal, 1995-96 and 2003-04 (Average per capita income in real 1995-96 rupees)*
- Table 8: *Average Daily Wages in Nepal, 1995-96 and 2003-04 (in real 1995-96 rupees)*
- Table 9: *District Production per hectare (1995-2002)*
- Table 10: *Median Livestock Holdings in Livestock Units, 1990-2003*
- Table 11: *Land and Labor Productivity in Nepal, 1995-96 and 2003-04*
- Table 12: *Urban Food Prices, 1995-2003*
- Table 13: *Top 20 Public Expenditures by Sector, 1999-2003*
- Table 14: *Real Irrigation per Capita Expenditure by Geographical and Development Region*
- Table 15: *Real Agriculture per Capita Expenditure by Geographical and Development Region*
- Table 16: *Real Road per Capita Expenditure by Geographical and Development Region*
- Table 17: *Access to Selected Facilities by Expenditure Quintile in Nepal 2003-04 and improvement since 1995-96*
- Table 18: *Access to Government Extension Services, 2003*
- Table 19: *Road Length in Nepal by Construction and Type 1995 and 2002 (kilometers)*
- Table 20: *Variable Abbreviations and Definitions in Regressions*
- Table 21: *Public Expenditures Patterns and Indicators of Conflict*
- Table 22: *District-level Benefits to Public Expenditure*
- Table 23: *Estimating the Benefits of Rural Roads using Jacoby's Approach*
- Table 24: *Panel Data Model Results*
- Table 25: *Simultaneous Equation Model Results*
- Table 26: *Summary of Returns to Irrigation, Agriculture and Road Expenditures*

## Executive Summary

As a largely rural society, most people in Nepal still depend upon agriculture as their major livelihood strategy. However, in part due to the domestic conflict, agricultural performance was disappointing during the past decades. With the peace process in place, it has become important to consider ways to stimulate agricultural growth. This report reviews government spending patterns and the political process of budgeting under the Ninth Five Year Plan. Using different data sources and methodologies, we examine the rates of returns to different types of expenditures in different regions. The use of diverse data sources and methods yield a range of estimates of the returns to agricultural public investment and reduces the risk of using a narrower set of results driven primarily by data source or methodology. When results converge across methods and data sources, it contributes to the confidence with which we can draw conclusions.

Overall, agricultural growth did not meet the expectations set forth in the Ninth Five Year plan over the period for which our analysis is conducted. Large gains in poverty reduction have been largely driven by rural to urban migration and remittances. However, the underlying approach outlined in the Ninth Five Year plan to reduce poverty by emphasizing the growth potential of rural farmers and the comparative advantages of Nepal's unique agro-ecological environment continues to have the potential to significantly improve rural welfare. The approach that seems most consistent with our results would be to increase the connectivity of these areas with rural roads, better integrating farmers with markets, and increasing their productive capacity by increasing their access to irrigation.

This recommendation is supported by our results which suggest that rural roads are one of the most productive public expenditures with marginal benefits that range between 6.43%-30.25% on consumption per capita and larger returns on plot values. Estimates of the impact of irrigation are also high in the range between 3.92% - 9.61%. However, the impact of agricultural spending on consumption per capita (1.36-2.98%) is much lower. More research is needed to find out why the returns to agricultural extension and subsidies are this low.

# 1. Introduction

Recent gains in poverty reduction in Nepal have not been primarily driven by increased agricultural growth or productivity increases in the agricultural sector. The ongoing civil conflict has disrupted the rural economy resulting in significant rural-to-urban migration and government spending has been diverted to address alternative objectives, namely defense and debt service. Because of the potential of the agricultural sector to contribute to poverty reduction, and with internal conflicts abating recently, it is critically important to evaluate the portfolios of public investment in the agricultural and rural sectors so as to better allocate limited financial resources to achieve higher agricultural growth and poverty reduction in rural farm areas. Despite the importance of this issue, there have been few rigorous reviews on agricultural and rural public expenditures. The World Bank conducted a qualitative assessment in 2000. As a complementary to and update of the early review, the purpose of this Agriculture Public Expenditure Review (AgPER) is to provide policymakers a range of estimates of the impact of public expenditures in the agricultural sector, and by doing so, assist them in evaluating different policy options available in the light of their impact on development.

Most previous studies estimate only a single set of rates of returns to different types of public investment. However, given the lack of clarity of the underlying mechanism of public expenditure allocation and attendant data problems in estimating the effects of public expenditures, the approach followed in this AgPER is to provide policymakers a range of estimates based on alternative data sources and methodological approaches. Specifically, this report makes a contribution by presenting results based not only on aggregate data at the district level, but also those based on microeconomic data at the household level. These multiple datasets are used to estimate the impact of public expenditures using different econometric models and methods. We point out the limitations of different methodologies, but underscore that all currently available methodologies for estimating returns to public investment have some defects. The use of diverse data sources and methods yield a range of estimates of the returns to agricultural public investment and reduces the risk of using a narrower set of results driven primarily by data source or methodology. When results converge

across methods and data sources, it contributes to the confidence with which we can draw conclusions.

A second contribution of this report is that we estimate rates of return disaggregated by regions. This is extremely important in the Nepalese context as Nepal is one of the most spatially heterogeneous countries in the world. By providing regional specific estimates, policy makers can make better informed decisions on the spatial allocation of government expenditures.

The report is arranged as follows. In Chapter 2, trends in the agricultural sector are evaluated. Chapter 3 reviews agricultural public expenditure and assesses its priority relative to other spending. Based on the review and evaluation, we then present and discuss our econometric strategy to identify and estimate the returns to public investment. Chapter 3 also discusses the policy making process in Nepal in light of the current political situation and the impact of conflict on public expenditure allocation. Apart from the political process that has impacted the allocation of public expenditure to the agricultural sector, the implementation of programs funded has been disrupted because of ongoing conflict. The effect of conflict on public expenditure is caused by the increased difficulty of government workers to implement projects in conflict zones, either because of the unwillingness of government staff to be posted in conflict areas, or the inability to travel to certain parts of the district because of threats of violence, as well as by the delay of funds received by district officials from the central government. Chapter 4 lays out the analytical framework to evaluate the rates of returns to different type of government spending in the agricultural and rural sectors. In Chapters 5, 6, and 7, the results of our estimates and their implications are discussed for agricultural production, rural infrastructure, and irrigation, respectively. Overall conclusions are presented in Chapter 8.

## 2. Recent Developments in the Agricultural and Rural Sector

The period for which this review is conducted (1997-2002) fell within Nepal's Ninth Five Year Plan. To that extent, annual budgetary allocations were, at least in principle, required to maintain some kind of alignment with the basic objectives and strategy of the Ninth Plan. In practice, Maoist insurgency, which escalated sharply especially after the year 2000, derailed much of the planning process, resulting in sharply increased claims of security-related activities on the national treasury. It is nevertheless instructive to provide some background information on the Ninth Plan and the long-term agricultural perspective plan to which it was anchored.

The key objective of the Ninth Plan was to reduce the national poverty headcount from 42 percent (as measured in the 1996) to 32 percent by the end of the plan period. The development of the agricultural sector was perceived to be the most important means of achieving this objective and the plan document indicated that "the agricultural sector will be given a lead role to play in poverty alleviation" recognizing that this sector was the "backbone of the economic development" and that the "majority of the people depend on it earn their livelihood." The strategy explicitly adopted in the plan to develop the agricultural sector was the long term Agricultural Perspective Plan (APP) (NPC 1995) that had a strong regional focus.

The APP recognized that while there was no scope for increasing land area to increase agricultural production, the numerous agro-ecological zones provided a basis for comprehensive agricultural development based on linking different regions of the country through markets and infrastructure and exploiting production and trade between them based on comparative advantage. In particular, the intensification of food grain production was emphasized for the Terai which was expected to boost the demand for high value agricultural crops produced in the hill and mountain regions. The main objectives of the APP were to accelerate the growth of agricultural income from 0.5% to 3%, to ensure food security by increasing per capita food availability from 270 Kg to 426 Kg, and narrow the gap of regional imbalance in agricultural development.

Targeted growth rates for key agricultural subsectors for the Ninth Plan are given in Table 1. The key programs planned to achieve these goals were the following:

- Cropping intensity and productivity enhancement program to increase crop yields in areas served by irrigation and road links,
- Development and promotion of high value agricultural commodities specially in areas served by roads and small irrigation,
- Development of the livestock sector that aims to increase the productivity and production of major livestock products such as milk, meat and eggs.
- Programs for the promotion of agricultural business to provide necessary impetus to commercialize the agriculture sector
- Irrigation facilities expansion and utilization program, with a focus on tube well irrigation in the Terai and small scale irrigation projects in both Terai and the mountainous regions
- Program to assure continuous supply of fertilizer through the involvement of the private sector in both the procurement and distribution of fertilizer
- Program to increase flow of agricultural credit for the Agricultural Development Bank
- Programs to develop agricultural roads and electrification, and
- Agricultural research and extension programs aimed at enhancing productivity in crops as well as livestock production

Despite the objectives of the Ninth Five Year Plan, growth in the agricultural sector has shown a mixed performance. The agricultural sector grew by 3.36% from 1995-2005, compared to the non-agricultural growth rate of 4.04% over the same period (Table 2). Agricultural growth rates fluctuated considerably, being negative (-.5%) in first part of 1990s and positive (.7%) in the second part of the 1990s (ANZDEC 2002).

Despite lower rates of growth, the agricultural sector is the primary employer of rural men and women and has been growing since 1995. Between the 1995-96 Nepal Living Standards Survey (NLSS 1) and 2002-03 survey (NLSS 2), the self-employed agriculture sector has grown in both urban and rural areas for men and women (Table 3). 51.8% of urban women and 85.4% of rural women were involved in self-employed agriculture in 2003. These figures represent a 9.1% growth rate in urban areas and a 3% increase in rural areas. Similarly, 19.9% of urban men and 64.9% of rural men are employed in self-employed agriculture. These figures represent a 6.1% increase in urban areas and a 4.1% increase in rural areas. Wage employment in agriculture is a much smaller segment of the market for both men and

women. This sector of employment has been decreasing in rural and urban areas for both genders.

Poverty has declined sharply in Nepal between 1995 and 2003 (Table 4), but the decline has been quite uneven between rural and urban areas. Poverty reduction measured by the headcount poverty rate declined by 26% for Nepal as a whole over the 8 year period. However, declines in urban poverty (56%) overshadow declines in rural poverty (20%). Inequality measured by the poverty gap has also decreased by 36%. Declines in the urban sector (67%) have likewise dominated declines in inequality in the rural sector (30%).

When poverty rates are disaggregated by sector of employment of the household head in Table 5, the declines in headcount poverty rates for both self-employed (24%) and wage earners (4%) in agriculture were the lowest within these subgroups, relative to self-employed traders (66% decline) or wage earning professionals (74% decline). This table illustrates that despite large decreases in poverty, these decreases have not been equally distributed across Nepalese society. Specifically, over the past 8 years, the lowest amount of poverty reduction has occurred in the agricultural sector relative to other sectors of the economy. Table 6 illustrates the importance of land holdings on poverty status and the changes in poverty rates based on a household's initial landholdings between 1995 and 2003. For households that held less than 0.2 hectares, the poverty headcount ratio was the highest (39%) compared to the other landholding categories. Poverty decreased by 17% for this group compared to a decrease by 15% for the group of households who held 0.2-1 hectares of land. However, households with access to over 2 hectares of land had poverty headcount decreases of 39% over the same time period.

Decreases in the poverty rates were accompanied by real increases in remittance receipts and nonagricultural wage income in both rural and urban areas. Between 1995 and 2003, migrant remittances increased by a massive 290% in urban areas and 139% in rural areas (Table 7). Nonagricultural wage income also increased in real terms by 48% in urban areas and 57% in rural areas. In urban areas, housing income also increased by 60%. In striking contrast to increases in remittances and non-agricultural wage income, agricultural wage

income has declined over the same time period. Urban areas saw declines of 20% in agricultural wage income, while rural areas exhibited a 13% decline. Table 8 lists the average daily wages in the two periods. The table illustrates that in urban areas the wage of skilled workers has significantly increased while unskilled labors have seen their wage coming down. This is perhaps due to the massive migration of unskilled labors from rural areas to cities as a result of domestic conflict.

These descriptive statistics suggest that while poverty has been decreasing in Nepal, these changes have not been driven by increases in agricultural income, or agricultural sectoral growth. Time series data on production and livestock at the district level from the Statistical Information on Nepalese Agriculture yields more detailed agriculture sector specific information. Table 9 summarizes data on production per hectare for cereals (maize, rice and wheat), cash crops and vegetables in the growing seasons in the period 1995/96 to 2002/03. Production per hectare in cereals grew by 1.4% per annum for maize, 1.3% for rice, and 3.3% for wheat. Cash crops grew by 0.9% and vegetables by 2.3%. These percentage increases in production per hectare should also be compared to the annual population growth rate of 2.25% observed between the census years of 1991 and 2001 (SINA 2005). Only wheat and vegetable production kept pace or exceeded population growth. Table 10 disaggregates livestock holdings in international livestock units by region and zone. Holdings of cattle and buffalo dominate the portfolio of animals that households own. Calculating the growth rate of herd sizes over the 1990-2003 period, growth rates in cattle (11.4%), buffalo (29.9%), sheep (-.09%) and goats (30%) were lower than population growth, while pigs (58.1%) and fowl (69.8%) had higher growth rates than the population growth rate.

Tables 11 disaggregates land and labor productivity by farm size (small, medium and large) and geographical region, respectively. The average gross area cultivated by households declined between the 1995 and 2003 NLSS surveys, and so has real profits per hectare and per worker. However for small and medium farmers, the average gross area cultivated has slightly increased by 0.09 hectares and 0.22 hectares respectively. Large farmers have decreased gross area cultivated by 0.72 hectares. Real profits per hectare have decreased for all farm sizes.

While agricultural production has intensified, food prices have uniformly risen in urban areas with more moderate increases in rural areas. According to Nepal Rastra Bank, Nepal's central bank, urban food prices increased by 54.8% between 1995/96 and 2003/04 (Table 12). Grains prices increased by almost 40%, while prices of meat, fish and eggs increased by 58.3%, the largest increase of any food sub-category.

In summary, migration has intensified over the past decade, primarily related to ongoing conflict. With more people leaving the rural areas, a decreasing share of wage employment and rising share of self-employment in agriculture is observed. However, the agricultural sector has had a mediocre performance. Given that most people still live in rural areas and rely on agriculture as the major livelihood, it is important to figure ways to boost agricultural growth and reverse the trend of declining farming profit. While poverty reduction has been impressive in Nepal since 1996, this reduction in poverty has not been driven by the agricultural sector as outlined in the Ninth Five Year Plan. The report will review public expenditure portfolios related to the agricultural and rural sectors and identify areas for the government to improve the efficiency of public expenditure allocations across sectors and regions.

### 3. Expenditures: Trends and Composition

This chapter reviews the patterns of public expenditures in various sectors with a particular focus on the agricultural and rural sectors. In addition to reviewing actual expenditures, we provide a brief overview of the budgetary process which has allocated a broad portfolio of funds to differing objectives, including the agricultural sector. The budgetary process in place during the review period was as prescribed by the Constitution of Nepal, 1990 and the Financial Administration Act, 1998. As required under the Constitution of the Kingdom of Nepal, 1990, the Ministry of Finance of the government of Nepal submits budget estimates every fiscal year before the joint session of the Parliament. Key agencies involved in the budgetary process are the Ministry of Finance, the National Planning Commission, the line ministries and the departments and projects functioning under each of these ministries.

The national budget is made of a “regular” and a “development” budget. While the regular budget includes all expenditures of recurrent character (eg. administrative and security expenses), the development budget includes all those projects and programs related to production or output. Further, while MOF takes the lead role in preparing the regular budget, the National Planning Commission takes the lead in finalizing the development budget. However, the process by which both types of budgets are formulated, appropriated, and spent is guided by the Financial Administrative Act of 1998. This Act requires all government agencies to formulate a budget for the forthcoming fiscal year based on a budget envelope and guidelines provided by the Ministry of Finance and/or the NPC.

In the case of regular budget, the annual budget process starts with the Ministry of Finance releasing the budget ceiling and working guidelines for budget formulation for each of the line ministries. This takes place in January of each year, about six months ahead of the start of the next fiscal year which starts in July. Each line ministry then forwards the guidelines and the indicative budget envelope, together with its own set of directives, to all agencies functioning under it, either at the district level or at the central level. These agencies formulate their respective budgets using these guidelines and send it back to the concerned ministry

where it is further vetted, consolidated, and forwarded to the Ministry of Finance for finalization. Once the Ministry of Finance receives budget from all line ministries, inter-ministerial meetings are held to further vet and finalize the national regular budget.

The formulation of the development budget takes place in a similar fashion, except that the initial budget envelope and the final vetting is done by the NPC in close consultation with the MOF. Once the regular and development budget are finalized, this is submitted to the ministerial cabinet for approval, after which it is presented to the national parliament in the form of a Budget Speech by the minister of finance. The minister of finance also submits the Appropriation Bill and the Finance Bill to the Parliament, which after discussions, are submitted to the king for approval after they become the Appropriation and Finance Act. Funds are then remitted from the central treasury to the concerned agencies through commercial banks, and central ministries authorize agency heads commit expenditures approved in budget document. Finally, all government agencies are required to submit progress reports on budget lines released, expended, and targets achieved to the MOF for evaluation.

While the administrative process for budget formulation, release, and monitoring is fairly well spelt out, this has not necessarily led to the proper alignment of the annual budgets to the longer-term five year plans. This is because in operational terms, the budgetary process and the management of public expenditure during the review period remained a “black box” to a large extent, and overall economic growth, including that of agriculture, remained below targets. The public expenditure review conducted by the World Bank in 2000 (World Bank 2000) provides an excellent critique of public expenditure management in Nepal and attributes the general ineffectiveness of public spending to serious deficiencies in budget planning, resource allocation, and expenditure management process. The escalation of Maoist insurgency and the sharp increase in security related expenditures towards the end of the review process further derailed public spending.

The top 20 expenditure categories over the 1999-2003 period (Table 13) reveal the policy priorities of the Government of Nepal. Education spending ranked the highest in government priority and was allocated 15.21% of the total expenditure. If loan payments are

disaggregated into internal and external debts, they account for the second and third leading priority of public expenditures. In the aggregate, loan payments account for the single largest budgetary obligation, representing more than 16% of government expenditure over the period. Debt service is four times as large as the expenditure on irrigation. Of the public expenditures that we consider in this AgPER, road transportation ranked highest with 22.95 million rupees, or 5.74% of expenditure between 1999 and 2003. Irrigation and agriculture were the 11th and 13<sup>th</sup> ranked priorities, respectively representing 3.82% and 2.85% of the allocated expenditure.

The inequality within the priorities of public expenditures is striking. If the defense and police sectors are aggregated into an overarching public security category, then loan payments, public security, education, and miscellaneous spending accounts for over 50% of the Government's spending. These expenditures are higher in part due to Nepal's protracted civil war. The large share of expenditures in public security also implies a new opportunity in Nepal: with peace in place, the government may be able to cut the defense spending and use it for more productive purpose.

Apart from looking at sectoral allocations, we also examine the allocation of expenditures across Nepal's geographical (Mountain, Hill, Terai) and development (Western, MidWest, FarWest, Central, and Eastern) regions. Taking irrigation as an example over the period 1999-2003, real investment per capita in irrigation in the Hill and Terai regions is relatively equal, though priority shifts between the two regions over the period (Table 14). Less than half real per capita irrigation investment is allocated to the Mountain region which is not altogether surprising considering the high cost of implementing irrigation schemes in the geographic environment. Figure 2 illustrates the trends in total, recurrent and capital expenditures in irrigation across geographical regions. Total per capita expenditure and capital real per capita expenditures track each other well. However, recurrent expenditure fluctuates widely in all regions. Across the development regions, the Central region captures the highest real per capita irrigation expenditures (18,398 NPR), followed by the MidWest region (13,013 NPR). Irrigation investment is allocated almost at parity between the Eastern (10,254 NPR) and Western (10,398 NPR) regions. Far West region's total real irrigation expenditure per capita (5,937 NPR) is only a third of the Central region's allocation.

Trends in agriculture public expenditure are illustrated in Table 15. Real per capita agriculture expenditures are highest in the Hill region (31,215 NPR) and the Mountain region (27,688 NPR), but almost 5 times lower in the Terai region (6,209 NPR). Allocations across development regions also differ. The Central (18,837 NPR) and Western (18,096 NPR) regions were allocated the highest real per capita agriculture expenditure. The Far West region's allocation of real agriculture expenditure per capita was, as in the case of irrigation expenditure allocation, the lowest relative to the other regions at 4,895 NPR. Relative to irrigation expenditures, agriculture expenditures have a much higher percent of share allocated to recurrent versus capital costs. This may be because large capital investments in irrigation are initiated by the government with maintenance costs left to local communities and beneficiaries. Agriculture spending is primarily allocated to extension services and fertilizer subsidies which do have high recurrent costs for the government. Figure 3 shows that while there is a large gap between the Terai and both the Hill and Mountain regions in total real agriculture expenditure per capita, the trend in capital real per capita agriculture expenditure is declining, most drastically in the Hill region.

The last type of public expenditure that this AgPER investigates is rural roads. Rural roads are essential to reducing travel time to markets and reducing transport costs which facilitates market integration. Table 16 disaggregates public expenditure on roads by geographic and development region. Highest among geographic regions in real road expenditures per capita is the Hill region with road expenditures at 46,738 NPR. The Mountain region had the lowest road spending per capita with only 6,116 NPR. With respect to development regions, the Central region received more than three times road expenditure per capita than other development regions. The other development regions had similar real per capita road expenditures with the highest in the Mid West region (9,603 NPR) and the lowest in the Western region (8,343 NPR). Trends in real road expenditure per capita (Figure 4) display mostly level effects between regions in total, recurrent and capital expenditures. Capital expenditures are much higher than recurrent expenditures within road spending.

These trends in public expenditures have been coupled by changes in access to government services. Tables 17, 18, and 19 illustrate changes in provision of public services between 1995-96 and 2003-04. Access time to facilities has generally improved, even across the expenditure quintiles as shown in Table 17. One notable exception is the disparity in improvements in the second to fourth expenditure categories relative to the large increases in both the lowest and highest quintiles. Table 18 documents the annual growth in road length in Nepal by construction and road type. By construction type, gravel roads expanded the most between 1995-2002 with a 7.9% annual growth rate. By road type, district roads expanded by 10.7% annually relative to urban roads (6.5%), feeder roads (1.3%), or highways (1%). Table 19 illustrates the lack of penetration of extension services to farmers. Only 5.57% had received any agricultural extension advice in the past year, while 13.7% had received some veterinarian advice. Despite these low rates of utilization, most farmers responded that their primary reasons for not obtaining extension advice were their perception that they did not need it.

The review does reveal large regional and sectoral variations in public expenditures. In the next several chapters, we will apply more rigorous approaches to investigate the effects of public investment to the observed patterns of welfare outcomes.

## 4. Analytical Framework

A large set of economic literature exists on measuring the impact of public expenditure including Jimenez (1995), Jacoby (2000), and Fan et al. (2002). One major challenge in evaluating impact is to isolate the effects that are only attributable to public expenditures and not other unrelated effects that may simply be correlated with public expenditures and outcomes. In assessing the impact of public expenditures, it is impossible to design a counterfactual scenario against which to compare differences as in the case of randomized experiment. In the literature, there are several different approaches used to measuring the impact of public expenditures. Each approach has advantages and disadvantages. Given the trade-offs of different approaches, this AgPER uses four different econometric methods to generate a range of estimates of the impact of agricultural public spending on household welfare and district level agricultural production. These alternative specifications serve as a robustness check for the different methodologies of identifying impact.

A necessary precondition for this type of analysis is adequate data sources. We have three different data sources for evaluating outcomes. This report draws primarily on (1) household survey data from the Nepal Living Standards Surveys 1 and 2 (Government of Nepal 2004, World Bank 2006) of which a small subset of repeated observations between the surveys exist, and (2) district level agricultural and livestock time series data from the Ministry of Agriculture and Co-operatives, and (3) public expenditures data disaggregated to the district and subsector level made available by the World Bank (World Bank 2007). The household data has household level outcome variables, such as agricultural income and consumption expenditures. The district level data, on the other hand, has information on district agricultural production. We make use of these data sets to construct alternative identification strategies. These are discussed below.

### *Instrumental Variable Approach*

A common way to specify the economic relationship that maps outcomes to expenditures is to use instrumental variables to isolate the impact of endogenous variables.

However, the challenge is to find valid instruments which are highly correlated with the expenditure variables but not with the unobserved variables. Strictly speaking, all government expenditures are endogenous with respect to the districts in which they are allocated. In this context, conflict data may serve as a plausible instrument that is orthogonal to the set of unobservable characteristics that may influence expenditure patterns, but correlated with public expenditures. If district conflict variables are indeed correlated with district public expenditures, then conflict data can be used as a plausible instrument in the cross-sectional and panel data analysis.

There are three potential pathways that could explain the correlation between conflict and public expenditure. First, the government may increase or decrease district level expenditures in order to seek peaceful settlement to conflict or increase security in the district. It may also withhold district funds due to difficulties in delivering funds in conflict zones or even punish districts with high incidences of violence. Second, government employees may not be able to travel to certain areas within the district to administer government projects because of the violence. Third, replacing or transferring government employees to districts with high rates of violence may be more difficult because of the unwillingness of government officials to put themselves or their families at risk of violence. We also include district population, ethnic share of Brahmins in the district, and differences between high and lowest elevation points in a district as instruments which may proxy for unobservable political distribution patterns of public expenditure.

The specification in equation (1) is defined to investigate the relationship between public expenditures and the instruments. Agricultural public expenditure<sup>1</sup> is disaggregated into agriculture, irrigation, and road spending per capita for the years 1999-2003. The conflict measure used is cumulative number of killings in a district over the period 1999-2003.<sup>2</sup> District population is estimated from the 2001 census population figures by scaling these

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<sup>1</sup> For the purposes of this report, agricultural public expenditure refers not to public spending with origins in the Ministry of Agriculture and Co-operatives, but any spending that influences agricultural outcomes. Most importantly this includes spending from the Ministry of Agriculture and Co-operatives, Ministry of Irrigation, and the Ministry of Rural Roads.

<sup>2</sup> The time series conflict data at the district level are from the Informal Sector Service Center (INSEC), a human rights group with district offices in all 75 districts that documents human rights abuses.

figures with district population growth rates. In addition, we include the ethnic share of Brahmins in a district and the difference in elevation within a district as other potential instruments. Region and belt dummies are included in the regression to control for unobserved fixed effects such as geography, regional political capital, and unobservable historical patterns of public expenditure.

$$\ln PubExp_d = \beta \ln Killings_d + \gamma region_d + belt_d + \varepsilon_{it} \quad (1)$$

The results of this regression are reported in Table 21. The conflict variables are statistically significant at the 1% level for agriculture and irrigation spending and the 10% level for road spending. The elasticities of agriculture, irrigation and road spending with respect to conflict are 36%, 29% and 50% respectively. Not only are the results statistically significant, they are large in magnitude.

Having shown that conflict is a potentially valid instrumental variable, we are now in the position to use the district level data to estimate the impact of various agricultural and rural expenditures. District level production data for crops such as rice, wheat, maize, “vegetables”, sugarcane, tobacco, potato, oilseed, lentil, chickpea, pigeon pea, blackgram, grass pea, horsepea, and soybean are regularly collected by the Ministry of Agriculture and Co-operatives. Because of the availability of district level time series of agricultural production data, a district level agricultural profit function can be estimated. It must however be noted that the quality of district level data often varies as a result of measurement errors in yield, missing data, and repetitions in yield values over consecutive years<sup>3</sup>. The following econometric specification is used to estimate the agricultural profits function exploiting the time series nature of the data.

$$\ln agprofits_{year} = f(AGexp, IRexp, RDexp, landarea, landelevation, districtpop, rainfall, region, belt) \quad (2)$$

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<sup>3</sup> Infrastructure variables are not included in the estimates of these district level profit functions because NLSS data is not representative at the district level. However, even if we were able to credibly aggregate the household data to the district level, these infrastructure variables would be likely correlated with the error term.

A potential source of bias in these estimates are the effects of weak instruments. To instrument for the three types of public expenditures (irrigation, agriculture and roads), we need an overidentifying set of instruments to control for the endogeneity of public expenditure on the estimates of agricultural profits. We have identified four instruments as plausibly exogenous: a district level conflict variable of number of persons killed due to conflict, district population, the ethnic share of high caste Brahmins in the district relative to other ethnic groups and the difference in the highest and lowest elevation within each district. To test the quality of instruments, we perform the Hansen-Sargan test of overidentifying restrictions which verifies whether the instruments are uncorrelated with the error term and are correctly excluded from the equation<sup>4</sup>. Despite these tests, doubts may persist about the reliability of instruments. Alternative approaches for evaluating the benefits of public infrastructure as a robustness check are discussed below.

### *Jacoby's Approach*

Jacoby (2000) suggests an innovative identification strategy to measure the benefits of rural roads at the household level using the value of farm land and distance to agricultural markets. Because land is an asset whose value is the discounted stream of agricultural profits, land values should increase as distance to markets decreases, a direct result of the installation of rural roads. This is because better roads and/or better access to roads decreases transportation costs, increasing agricultural profits. Jacoby's specification estimates the relationship between median travel times to markets or agricultural cooperatives, controlling for household ( $X$ ) and district ( $Z$ ) characteristics.

$$\ln \text{plotvalue} = \ln \text{traveltime} + \beta X + \gamma Z + u \tag{3}$$

Jacoby's approach addresses several econometric problems unresolved by previous evaluators of rural road projects. These include the endogeneity of location decisions inherent in compensating variations relating consumption and the distance to markets. This model was originally proposed to evaluate the impact of rural roads. However, it can also be applied to

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<sup>4</sup> These results are available upon request.

examine the impact of other infrastructure, such as irrigation, because irrigation is used as a proxy for land quality to which a return is estimated in Jacoby's specification.

One problem of this approach is that it evaluates only one outcome variable, agricultural profit, even though in rural areas, landless labor is common. By looking at only agricultural profit, this approach omits the impact of infrastructure on those people without land. In addition, travel time is not only affected by distance to road but also by travel mode. With the increasing availability of motorcycles, it is possible to see a drop in travel time even if there is no change in access to road. Perhaps, most importantly, Jacoby's approach yields an interesting alternative to estimating the benefits of rural roads, but comparisons to other marginal benefit ratios is unclear due to the incomparability of units from other approaches that investigate changes in household consumption.

#### *Approach exploiting household panel data*

The two rounds of household survey data have a panel component of 959 households. Therefore we can use this panel data set to estimate the impact of public infrastructure on changes in per capita consumption or income. We estimate changes in real consumption per capita and real agricultural income per capita controlling for changes in household ( $X$ ) and district characteristics ( $Z$ ) and instrument for public expenditure with conflict variables and district population. We use the same set of instruments tested in equation 1.

$$\Delta Consumptionpc_{hd} = \beta \Delta X_{hd} + \alpha Z_d + Exp_d + u_{hd}$$

$$\Delta AgIncomepc_{hd} = \beta \Delta X_{hd} + \alpha Z_d + Exp_d + u_{hd} \quad (4)$$

In estimating the elasticity of the outcome variable with respect to public expenditure, we use the coefficient estimate for public expenditure scaled by the ratio of the mean of the outcome variables over the mean of the public expenditure variable.

## *Simultaneous Equation Modeling of the Effects of Agriculture Public Expenditure*

One key limitation of the above three approaches is that the channels of public investment are considered only in their reduced form, rather than fully modeled. Hence a fourth approach used is to explicitly delineate the pathways through which public expenditures influence farm and nonfarm sectors, wages, technology and household consumption in a simultaneous equations system. This kind of structural approach can correctly identify the relationship between public expenditures and increases in welfare. However, a structural approach necessitates higher data requirements and correct econometric specifications. In addition, this approach stands critically upon the key assumption that the model is correctly specified. If there is a specification error, such as a key omitted variable in one equation, it will lead to the contamination of the estimations of other equations. Recent developments in the literature on the evaluation of public investment has placed emphasis on structural modeling using a simultaneous equations approach where both the benefit and cost side of public investment is estimated.

Fan, Zhang, and Rao (2004) and Fan, Zhang, and Zhang (2002) conceptualize the relationship between public investment and poverty reduction as in Figure 1. This figure illustrates the impact of government expenditures on inputs into agricultural production, namely access to irrigation, agricultural services, and roads which decrease travel time to markets and facilitates access to inputs. These government expenditures and their subsequent impact on production, increase farm income, non-farm wage income through the creation of non farm enterprises, and unearned household income, namely in Nepal through remittances. Farm, wage and remittance income then is allocated within the household to consumption, investment and savings.<sup>5</sup> That which is allocated to consumption reduces the measured poverty status of their household. Fan et al.'s primary insight is to estimate the marginal benefit of public expenditure which we modify given our data as in Equation 5. The marginal benefit of public expenditure is the product of the change in consumption triggered by a unit of

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<sup>5</sup> In the figure, we list price as an endogenous variable. It is mainly so at the macro level. However, due to lack of disaggregate price information at district level, we do not model the determinant equation of prices. Moreover, given that the systems equation approach is based on household level data and price is largely exogenous to households, it is not necessary to model the price equation.

investment in and the change in investment level triggered by a change in the public expenditure. This approach requires time series on government expenditures in addition to the data requirements of the other above approaches. The two stage simultaneous equation estimation of the benefits side is derived from the system of equations (6), and the cost side is derived by constructing the input output ratio of infrastructure to expenditure using the household survey data and the public expenditures data set. Variable names are abbreviated in the system of equations specification below, but are defined in Table 20.

$$\text{Marginal Benefit} = \frac{\partial \text{Consumption}}{\partial \text{Infrastructure}} \times \frac{\partial \text{Infrastructure}}{\partial \text{Expenditure}} \quad (5)$$

*System 1: Benefits*

**Poverty Equation:**

$$\ln \text{cons} = f(\text{FarmIncome}, \text{WageIncome}, \text{Remittances}, \text{foodprices}, \text{zonedummies}) \quad (6)$$

**Income Equations**

$$\ln \text{FarmIncome} = f(\text{foodprices}, \text{menwork}, \text{womenwork}, \text{landsize}, \text{districtpop}, \text{zonedummies}, \text{ethnicity}, \text{conflict}, \text{traveltime}, \text{extension}, \text{irrigation}, \text{rainfall})$$

$$\ln \text{WageIncome} = f(\text{nworkmen}, \text{nworkwom}, \text{ethnicity}, \text{conflict}, \text{traveltime}, \text{districtpop}, \text{zonedummies})$$

$$\ln \text{remittances} = f(\text{traveltime}, \text{ethnicity}, \text{femaleheaded}, \text{locationofmigrant}, \text{zonedummies}, \text{districtpop}, \text{conflict}, \text{rainfall}) \quad (7)$$

*Estimating the Marginal Cost of Investment*

In order to calculate the benefit-cost ratio, it is necessary to estimate the marginal cost of infrastructure investment. Using the reported changes in infrastructure access from the survey data gives us a measure of changes in access to infrastructure. We also have the government expenditure information from 1998 to 2003, we can calculate the marginal cost of investment as the ratio of average annual change in infrastructure variables from 1996 to 2002 to the average annual government spending in the period of 1998-2002.

In the next three chapters (Agriculture Expenditures, Rural Infrastructure Expenditures and Irrigation Expenditures), the results of these methodologies are presented to provide a range of estimates of the impact of public expenditures on consumption per capita, access to services, and agricultural profits.

## 5. Agriculture Expenditures

The largest proportions of agriculture spending are allocated to agricultural extension services and fertilizer subsidies. The effectiveness of agricultural spending is often questioned on the grounds that larger farmers may be able to attract more government resources than small farmers because they may be wealthier and it is easier for extension workers to work with one large farmer rather than many small farmers. Total agriculture spending also has a larger percentage of recurrent expenditure relative to capital expenditures.

Using district level production data and instrumenting the lagged agriculture expenditures while controlling for other types of public expenditures, the returns to agriculture spending are large and significant for maize (13.2%) and rice production (12.3%), but insignificant for wheat production (Table 22). When disaggregated by geographic region, the effects of agriculture expenditures on agricultural profits are not significant. This does not necessarily mean there is no impact of agricultural expenditures. Disaggregating the 75 districts into geographic zones yields smaller sample sizes with which to estimate the impact of expenditure. This creates less variation in the data which results in more difficulty in estimating relationships within the data. Moreover, with only one year sectional data, it is hard to control for omitted variables in the regressions.

To fully utilize the multiplicity of data sources available and reduce the potential omitted variable problems of the cross-sectional data, estimates of the returns to agricultural expenditures on consumption per capita are also estimated using panel data and the model of simultaneous equations (Table 24 and 25). When changes in consumption were used with repeated observations on households, returns to agriculture expenditures were found to be modest at only .9%. The simultaneous equations approach yields estimates of the returns to fertilizer use on consumption per capita. Returns to fertilizer use and agricultural extension services were estimated to have returns of 2.98% and 1.36% with the simultaneous equation system which concord with the panel data results.

The evidence from the different estimation methodologies suggests that returns to agriculture are low. The impact of agricultural expenditures on consumption per capita is

mented compared to directly measured estimates of agricultural output or income. This may be because households distribute the gains in agricultural profits not only through higher consumption, but also through savings and investment to secure future income. The higher estimates of agricultural returns when district level data is used may also be due to the lower sample size and the effect of influential districts or unobserved positive production shocks for which we could not control. With the larger sample size from household level estimates using both panel data and simultaneous equations, the returns to agriculture range between 1-3%. These results are not altogether unexpected given the low percentage of households in the NLSS 2 survey that report visitation by an agricultural or veterinarian extension agent (Table 19). Only 5.57% of households had received at least one agricultural extension visit, while only 13.7% of households reported receiving a veterinary extension visit.

## 6. Rural Infrastructure Expenditures

In theory, rural roads have multiple pathways of impact on household welfare. Decreased travel time to markets or agricultural cooperatives lowers transportation costs of marketing primary products and gaining access to necessary farm inputs, such as fertilizer and seed. Rural roads can also increase land values closer to roads as they capture the benefits of increased access to markets and lower travel times. Using the multiple data sources available for Nepal, the benefit incidence of road expenditure on consumption per capita, agricultural income and agricultural production can be estimated.

Investigating the impact of road expenditures on district-level production, the elasticity of maize yields with respect to road expenditures was estimated to be 1.69% (Table 22). The rice elasticity with respect to roads was 2.44%, while the effect of increased road expenditures on wheat production was 1.99%. When returns to roads were disaggregated across geographic zones, most effects were not statistically significant<sup>6</sup>. Roads did have an impact on maize production in both Mountain and Hill regions with 5.81% and 4.13% returns, respectively. Wheat profits increased in the Hill region by 4.09% with respect to road expenditures.

Using Jacoby's approach to control for the potential endogeneity of locational preferences on the impact of rural roads, large benefits associated with reduction of travel time were estimated. Table 23 displays the results of the replication of Jacoby's method using NLSS 1 and 2 data. Comparing the point estimate across the two surveys illustrates the increasing benefits of rural roads. In the 1995/96 period, the change in plot value with respect to travel time was 26%. This greatly increased to 48.1% in the 2002/03 period. When these results are used to calculate the marginal benefit to rural roads using Jacoby's approach the marginal benefit to rural roads in 1996 is 26.41% and 60.78% in 2002<sup>7</sup>. These large returns are driven in part by the large increases in median land values which increased from 16,000 NPR

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<sup>6</sup> Especially with respect to the district level data, an effect that was estimated to statistically insignificant may not necessarily be an insignificant effect. Because these data have a small sample size (75) at the district level, associations in the data may not be as strong because of lack of data rather than an absence of some underlying effect.

<sup>7</sup> Because land value reflects the lifetime earnings due to change in access to road, here we use a discount rate of 4% to calculate the annual increase in land value.

in 1996 to 50,000 NPR in 2002. They also may overestimate the actual rates of return to roads because many households do not own land in Nepal, so these returns would only apply conditionally to land holders. These returns, though high to land, may not transfer one to one into increases in household welfare, as land is an illiquid asset, whose stream of income may be difficult to realize given financial market underdevelopment in rural areas.

The impact of road expenditures on changes in consumption per capita between 1995/96 and 2002/03 using the panel data (Table 24) suggests that the benefit incidence of these expenditures is 3.57%. Road expenditures produced no significant changes in agricultural income. Returns to rural roads estimated using the system of simultaneous equations are much higher at 30.25%. This may be because the simultaneous equations approach is capturing the multiple pathways by which rural roads improves household welfare, both with respect to lowering marketing and transportation costs to get primary products to market and with the lower cost of purchasing farm inputs and non-food items. When looking at the impact of road expenditures on the three outcome variables, it is noted that the most important channel is through remittance and wage income. In other words, improvement in road access provide with farmers more non-farm and migration opportunities. Therefore, it is not surprising that the simultaneous equation approach gives a higher estimate on the impact of road investment than the regression on agricultural income and profit.

## 7. Irrigation Expenditures

Irrigation expenditures finance large scale canal based irrigation schemes as well as smaller scale village-level tubewell investments. These irrigation schemes allow farmers to increase yields by controlling water at critical moments in the crop's growth cycle. While rural roads decrease input costs and agricultural expenditures decrease input costs and increase farmer's technical knowledge, irrigation expenditures directly impact the farmer's production technology.

However, we find no significant effects of irrigation expenditures using the district level data (Table 22). Jacoby's approach, panel data estimates and the simultaneous equations approach yield statistically significant estimates of the impact of irrigation. Elasticity of plot value with respect to canal irrigation was 22.5%. Tubewell irrigation had insignificant effects on plot value. When the marginal benefits calculation is made using both the 1996 and 2002 point estimates, the returns to irrigation as measured with plot values range from 16.62% to 36.86%. Using the panel data, we estimate the impact of irrigation expenditures on changes in consumption per capita and agricultural income per capita. In the panel specification where changes in consumption per capita and agricultural income are used as the outcome variables, the increase in real consumption per capita is 2.47% while the change in agricultural income is insignificant. Under the simultaneous equations model, canal irrigation has a significant and large impact on consumption per capita with a return of 9.61%.

With the exception of the district level data, the returns to irrigation on consumption per capita are statistically significant. When the cost and benefit elasticities with respect to irrigation are used to estimate the overall return to irrigation in Table 26, irrigation is the second most productive public expenditure with marginal benefits that range between 3.92%-9.61% on consumption per capita variables and larger returns on both plot value and agricultural profits.

## 8. Conclusion

The report provides a quantitative assessment of agricultural and rural expenditures in Nepal using different methods and alternative data sources. Table 26 summarizes the different estimates of returns to irrigation, agriculture and road expenditures. Robust across different methodologies are the results that public expenditures on irrigation and rural roads have relatively large impacts on household consumption per capita. The impact of agriculture spending, on the other hand, is small. Thus, even while taking a significantly different approach, the general results of this study are consistent with and tend to support the broad conclusions reached in an earlier public expenditure review that partially overlapped the period under study (World Bank 2000).

During the review period, agriculture expenditures were focused almost equally on provision of fertilizer and other inputs, research and extension, and livestock development. However, as the World Bank study concluded, much of this expenditure was ineffective. Until the end of 1999, fertilizer supply was subsidized and was mainly handled by the Agricultural Inputs Corporation “yet this was inadequate to meet the need of farmers” (World Bank 2000 p. 51). Similarly, the report concluded that “the MOA had failed to provide farmers with research and extension services” and actually recommended that MOA’s direct role in providing research and extension services be phased out. On the irrigation front, the period witnessed heavy subsidization of private and community tubewells, shallow as well as deep. Even though subsidy was large (40-90%), these tubewells were farmer owned and operated and therefore produced significant incremental output and incomes. Finally, the significant progress found in the transportation sector in terms expenditure planning, institutional development, and capacity building, as reported by the World Bank review, appears to have created significant payoffs in raising production and income levels.

Overall, however, agricultural growth did not meet the expectations set forth in the Ninth Five Year plan. Deep weaknesses in budget planning and implementation no doubt contributed to this state, and large gains in poverty reduction have been largely driven by rural to urban migration and remittances. Management of public expenditure in turn was

significantly marred by poor governance, and this was severely accentuated by rising insurgency. Poor governance was all encompassing and manifested itself practically everywhere, from deficiencies in budget planning and expenditure management to general corruption and to severe weaknesses in public administration.

Much of what maligns the system, especially in the areas of budgetary allocation, release, and monitoring processes remains poorly understood even though the processes are fairly well clarified on paper. The 2000 Public Expenditure Review Commission's recommendation for framing a medium term expenditure framework over the annual budgeting process so as to align it to longer term strategic goals is a step in the right direction. However, just as important is the need to institute serious reforms in public administration that ensures that financial expenditures translate to real and discernible investments in the rural areas of the country. As we see from the case of roads and irrigation, investments that materialize, even if not in the most cost effective manner, have an impact on incomes and consumption levels.

The underlying approach of the Agricultural Perspective Plan that emphasizes unlocking the growth potential of rural farmers by exploiting the comparative advantage of Nepal's unique agro-ecological environment is basically sound. However, in order to achieve this long term goal, it is important to pinpoint in much greater detail the serious institutional failures in agricultural research, extension and input supply systems. Only then can corrective measures be identified and successfully undertaken. Overall, the most promising approach that is consistent with our findings is to increase the connectivity of remote areas with rural roads, better integrating farmers with markets, and increasing their productive capacity by increasing their access to irrigation and agricultural technology.

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## Appendix 1: Figures

Figure 1: Effects of Government Expenditures on Rural Poverty Adapted from Fan et al. (2002)

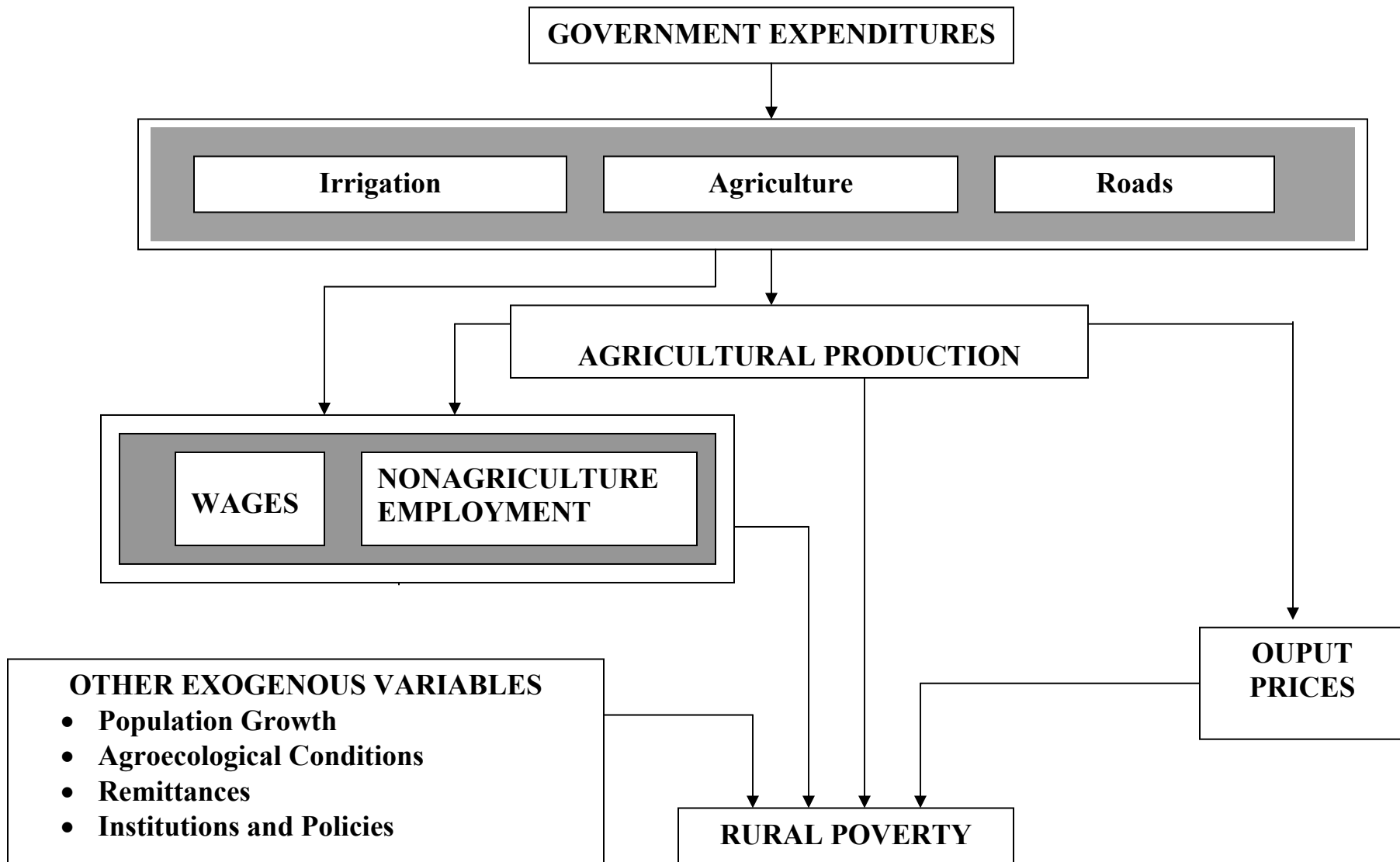
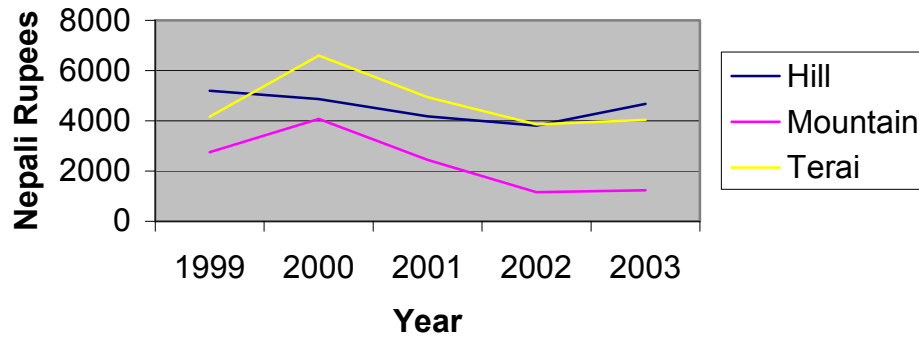
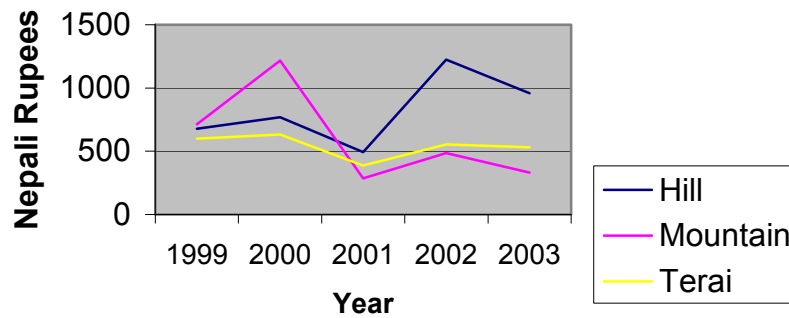


Figure 2: Trends in Total, Recurrent, and Capital Irrigation Expenditures, 1999-2003

**Total Real Irrigation Expenditures per Capita, 1999-2003**



**Recurrent Real Irrigation Expenditure per Capita**



**Irrigation Real Capital Expenditure per Capita**

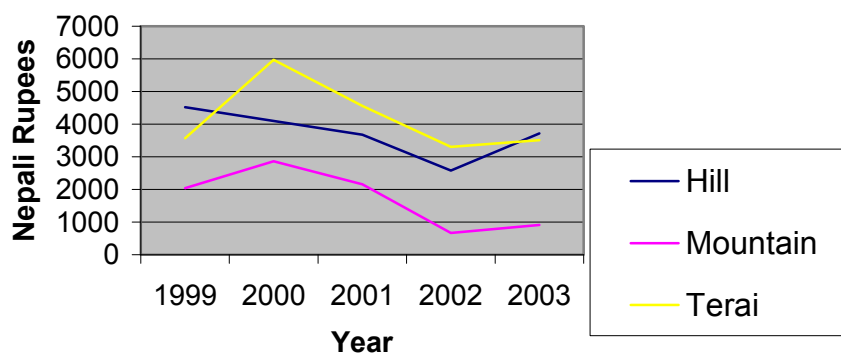
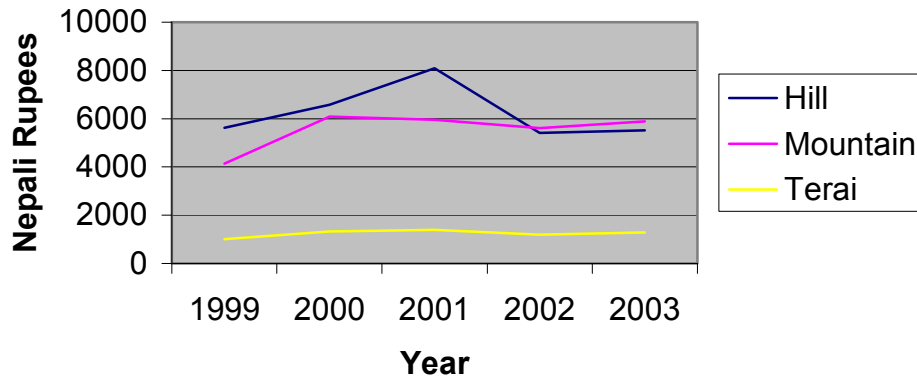
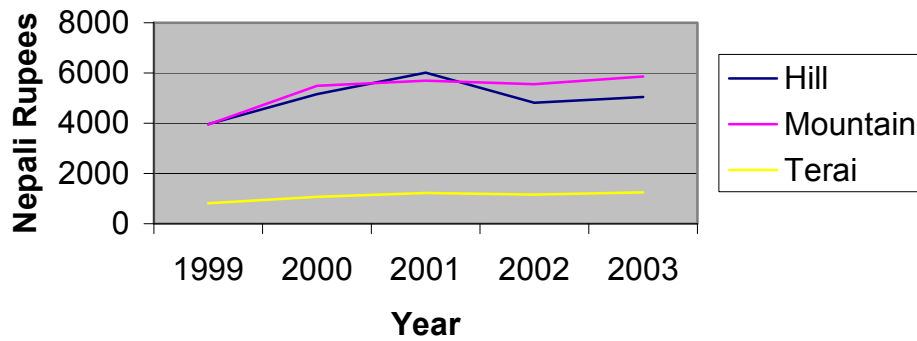


Figure 3: Trends in Total, Recurrent, and Capital Agriculture Expenditures, 1999-2003

**Total Real per Capita Agriculture Expenditures**



**Recurrent Real per capita Agriculture Expenditures**



**Capital Real per capita Agriculture Expenditure**

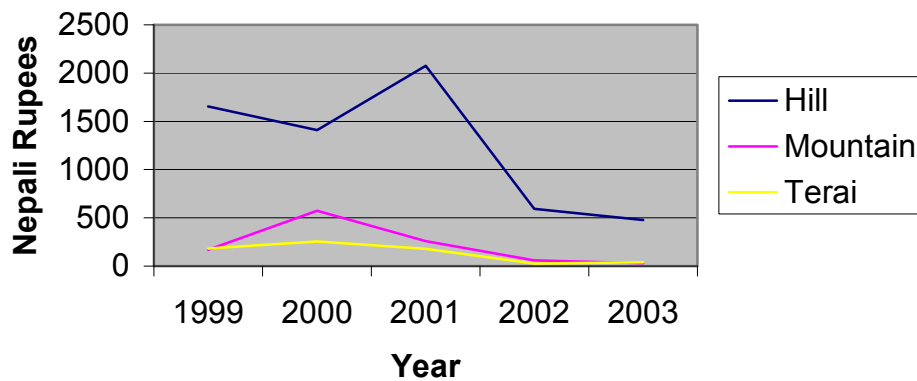
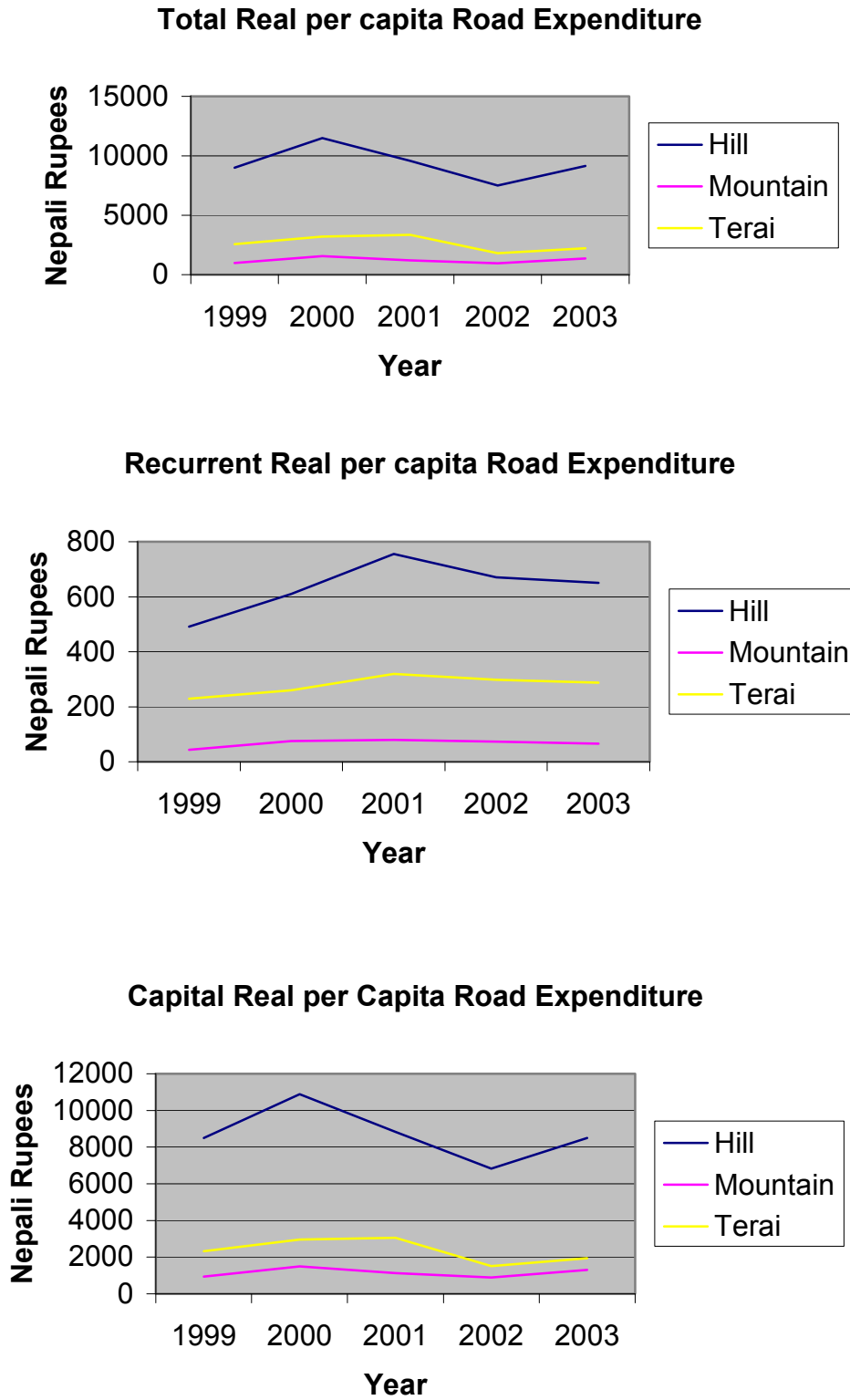


Figure 4: Trends in Total, Recurrent, and Capital Road Expenditures, 1999-2003



## *Appendix 2: Tables*

*Table 1: Major Agricultural Growth Targets of the Ninth Plan (1997-2002)*

<b>Subsectors</b>	<b>Targeted Annual growth rate</b>
Foodgrains	5.18
Cash crops	6.50
Pulses	6.04
Horticulture	3.54
Livestock	6.00
Fisheries	8.76
<b>Agriculture sector as whole</b>	<b>5.33</b>

Table 2: Annual Growth Rates of GDP by ISIC Division, 1995/96 To 2004/05

	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04R	2004/05P
Agriculture Fisheries and Forestry	3.81	4.36	0.85	2.84	4.89	5.48	2.23	2.5	3.86	2.8
Mining and Quarrying	13	6.79	1.26	3.73	4.56	4.49	1.55	1.93	0.53	0.71
Manufacturing	9.04	7.05	3.42	5.29	7.2	3.76	-9.97	1.98	1.73	2.75
Electricity, Gas and Water	19.28	1.78	-4.13	5.67	14.34	17.44	10.01	23.12	2.51	7.98
Construction	7.1	6.63	2.2	6.8	9.6	0.87	1.12	1.79	0.19	-2.43
Trade, Restaurant and Hotel	4.51	4.07	5.76	3.89	6.76	1.52	-10.09	3.31	6.03	-3.02
Transport, Communication and Storage	5.46	7.74	8.08	6.8	7.02	6.19	1.63	4.3	5.26	5.37
Finance and Real Estate	7.61	4.71	5.87	5	5.08	1.72	3.31	3.28	2.13	2.92
Community and Social Services	6.16	3.61	7.62	6.62	3.97	13.25	1.85	3.1	2.87	3.91
Agriculture	3.81	4.36	0.85	2.84	4.89	5.48	2.23	2.5	3.86	2.8
Non-agriculture	6.99	5.43	4.98	5.63	6.83	4.5	-1.91	3.5	2.87	1.56

R-Revised Estimates

P-Preliminary Estimates

Source: *Statistical Yearbook 2003*, Central Bureau of Statistics

Table 3: Employment sectors in Nepal, 1995-96 and 2003-4

	Men		Women	
	1995-96	2003-04	1995-96	2003-04
<b>Urban</b>				
Self-employment agriculture	13.8	19.9	42.7	51.8
Self-employment manufacturing	10.2	10.3	4.3	7.5
Self-employment trade	19.1	13.7	19.9	13
Self-employment services	5.3	10.3	1.9	5.5
Wage employment agriculture	4.1	1	7.5	2.8
Wage employment skilled nonagriculture	9.2	12.6	7.3	6.5
Wage employed unskilled nonagriculture	38.4	32.3	16.4	12.8
Total	100	100	100	100
<b>Rural</b>				
Self-employment agriculture	60.8	64.9	82.4	85.4
Self-employment manufacturing	2.5	3.8	1.2	1.1
Self-employment trade	5.1	3.7	2.8	2.5
Self-employment services	1.7	3.1	0.3	0.5
Wage employment agriculture	14.7	9.3	11.5	8.6
Wage employment skilled nonagriculture	2.4	2.6	0.5	0.7
Wage employed unskilled nonagriculture	12.7	12.7	1.5	1
Total	100	100	100	100
<b>Poorest 2 quintiles</b>				
Self-employment agriculture	58.4	63.5	79.4	83.4
Self-employment manufacturing	3	4	1.6	0.8
Self-employment trade	4	1.8	1.4	0.8
Self-employment services	1.2	1.9	0.1	0.4
Wage employment agriculture	18.3	13	15.7	13
Wage employment skilled nonagriculture	0.5	0.8	0.1	0
Wage employed unskilled nonagriculture	14.6	15	1.6	1.6
Total	100	100	100	100

Source: *Nepal: Resilience Amidst Conflict* p. 44

Table 4: Poverty in Nepal, 1995-96 and 2003-04 (percent)

	Headcount Poverty Rate (percent)			Poverty Gap (x 100)			Squared Poverty Gap (x100)		
	1995-96	2003-04	Percentage change	1995-96	2003-04	Percentage change	1995-96	2003-04	Percentage change
Nepal	41.8	30.9	-26	11.8	7.5	-36	4.7	2.7	-42
Urban	21.6	9.6	-56	6.6	2.2	-67	2.7	0.7	-13
Rural	43.3	34.6	-20	12.1	8.5	-30	4.8	3.1	-37

Source: *Nepal: Resilience Amidst Conflict* p. 6

Table 5: Poverty by employment sector of the household head  
in Nepal, 1995-6, and 2003-4

	Headcount Poverty Rate (percent)			Distribution of the Poor			Distribution of the Population		
	1995-96	2003-04	Percentage change	1995-96	2003-04	Percentage change	1995-96	2003-04	Percentage change
<b>Self-employed</b>									
Agriculture	43.1	32.9	-24	60.7	66.9	10	58.8	62.7	7
Manufacturing	41.4	31.2	-25	3.4	4.5	32	3.4	4.4	29
Trade	32.2	11.1	-66	4.3	1.6	-62	5.6	4.5	-19
Services	25.3	14.4	-43	1	1.5	53	1.6	3.2	99
<b>Wage earner</b>									
Agriculture	55.9	53.8	-4	15.7	10.9	-31	11.7	6.2	-47
Professional	8.3	2.1	-74	0.4	0.2	-53	2.2	2.9	35
Other	39.7	28.8	-28	10.6	10	-6	11.1	10.7	-4
Unemployed	9.5	2.9	-69	0.1	0	-68	0.3	0.2	-23
Nonactive	30.5	26.9	-12	3.9	4.4	14	5.3	5.1	-4
Total	41.8	30.8	-26	100	100		100	100	

Source: *Nepal: Resilience Amidst Conflict* p. 13

Table 6: Poverty measurement by land ownership in Nepal, 1995-6 and 2003-4  
(rural areas only)

Landholdings (hectares)	Poverty Headcount Rate (percent)			Distribution of the Poor			Distribution of the Population		
	1995-96	2003-04	Change (percent)	1995-96	2003-04	Change (percent)	1995-96	2003-04	Change (percent)
Less than .2	48	39	-17	23	25	10	21	22	7
0.2-1	45	38	-15	44	51	17	42	47	11
1-2	39	27	-29	19	16	-14	21	20	-3
More than 2	39	24	-39	15	8	-49	16	11	-32
Total	43.3	34.6	-20	100	100		100	100	

Source: *Nepal: Resilience Amidst Conflict* p 16

*Table 7: Sources of household income in Nepal, 1995-6 and 2003-4 (average per capita income in real 1995-6 rupees)*

	Urban			Rural			Nepal		
	1995-96	2003-04	Change (percent)	1995-96	2003-04	Change (percent)	1995-96	2003-04	Change (percent)
Farm Income	1,446	1,433	-1	3,246	3,252	0	3,122	2,983	-4
Agricultural wage income	151	121	-20	710	621	-13	672	547	-19
Nonagricultural wage income	3,543	5,234	48	829	1,298	57	1,016	1,880	85
Nonagricultural enterprises	3,688	4,778	30	649	917	41	859	1,489	73
Property income	300	493	64	36	44	22	55	111	103
Remittances income	499	1,944	290	548	1,306	139	544	1,401	157
Housing income	2,935	4,687	60	596	690	16	757	1,282	69
Other income	553	910	64	138	355	158	167	437	163
Total	13,115	19,601	49	6,753	8,484	26	7,191	10,129	41

Source: *Nepal: Resilience Amidst Conflict* p. 46

Table 8: Average daily wages in Nepal, 1995-6 and 2003-4 (in real 1995-6 rupees)

	Agriculture			Nonskilled nonagriculture			Skilled nonagriculture		
	1995-96	2003-04	Change (percent)	1995-96	2003-04	Change (percent)	1995-96	2003-04	Change (percent)
Urban	42	58	38	98	92	-6	138	461	234
Rural	44	55	25	79	98	24	81	135	67
<i>Region</i>									
Kathmandu				103	83	-19	173	672	288
Other urban	40	57	43	91	101	11	111	170	53
Rural Western Hill	49	54	10	75	91	21	72	111	54
Rural Eastern Hill	37	54	46	84	90	7	83	137	65
Rural Western Terai	50	63	26	81	94	16	97	126	30
Rural Eastern Terai	42	54	29	75	113	51	80	159	99
<i>Education</i>									
Illiterate	43	52	21	73	83	14			
Less than 5	53	61	15	82	99	21			
5-7	44	65	48	94	99	5			
8-10	45	63	40	86	108	26	75	113	51
11+				121	142	17	121	426	252
<i>Gender</i>									
Male	48	63	31	84	104	24	102	351	244
Female	39	47	21	59	54	-8	65	126	94
Nepal, real prices	44	55	25	81	97	20	94	295	214
Nepal, current prices	44	82	86	81	143	77	94	436	364

Source: *Nepal: Resilience Amidst Conflict* p. 48

*Table 9: District Production per hectare (1995-2002)*

Year	Maize	Rice	Wheat	Cash crops	Vegetables
1995/96	1.68	2.26	1.49	6.78	8.60
1996/97	1.66	2.27	1.50	6.82	8.73
1997/98	1.73	2.25	1.50	6.80	9.33
1998/99	1.89	2.34	1.54	6.92	9.31
1999/00	1.73	2.39	1.65	6.56	9.37
2000/01	1.78	2.45	1.68	6.81	9.79
2001/02	1.80	2.47	1.74	7.29	9.94
2002/03	1.87	2.50	1.88	7.27	10.15

Cash crops: Potatoes, oilseed, tobacco, sugarcane

Source: *Statistical Information on Nepalese Agriculture (Times Series Information)*

Table 10: Median Livestock Holdings in Livestock Units, 1990-2003

Region	Cattle	Buffalo	Sheep	Goats	Pigs	Fowl	Duck	Total Livestock Units
Mountain	39250	21520	1669	3887	134	321	3	63944
Hill	62959	45392	730	8482	1596	1831	12	124037
Terai	93618	55927	225	8998	1264	2144	115	158287
Zone								
Central	68401	39600	376	9994	1126	2712	41	118997
Eastern	68754	39560	706	9700	4222	1533	18	118862
Far West	68088	43459	402	5250	146	628	3	124226
Mid West	62959	35480	2735	7856	1208	1120	3	121466
Western	52599	63539	632	7094	1118	1909	13	140668
Total	66173	43459	748	8451	1265	1647	16	123676

Source: *Statistical Information on Nepalese Agriculture (Times Series Information)*

Livestock Units: 1 buffalo= 1 LU; Cow=.7 LU; Pigs =.2 LU; Sheep/Goat=.1 LU; Fowl/Duck=.01 from Otte and Chilonda (FAO 2002)

*Table 11: Land and Labor productivity in Nepal, 1995-6 and 2003-4*

	1995-96				2003-04			
	Small farmers	Medium farmers	Large farmers	All farmers	Small farmers	Medium farmers	Large farmers	All farmers
Average gross cultivated area (per household)	0.86	2.23	6.62	2.11	0.95	2.45	5.9	1.81
Cropping intensity (number of seasons)	1.61	1.61	1.62	1.61	1.8	1.81	1.78	1.8
Number of workers per hectare	4.1	1.8	0.8	3	3.5	1.8	1	2.8
Gross crop output per hectare	15,394	11,098	11,007	13,626	13,733	11,249	9,518	12,707
Real profits per hectare	12,335	9,270	8,712	11,001	10,707	8,495	7,427	9,841
Gross crop output per worker	4,913	8,033	17,414	7,862	4,911	8,728	14,306	6,785
Real profits per worker	3,919	6,333	13,689	6,076	3,768	6,168	10,172	4,997

Source: *Nepal: Resilience Amidst Conflict* p. 64

*Table 12: Urban Food Prices, 1995-2003*

Fiscal Year	Overall Index	All Grains	Rice	Pulses	Vegetables and Fruit	Spices	Meat, Fish and Eggs	Milk and Milk Products
1995/96	100	100	100	100	100	100	100	100
1996/97	108.1	109.1	106.5	106.1	103.7	105.7	111.1	112
1997/98	117.1	112.5	110.1	103.6	121	113.8	120.6	120.6
1998/99	130.4	133.5	132.9	123.6	145.1	139.3	128.5	132.1
1999/00	134.8	145	145.8	118.7	120.6	141.2	134	136.9
2000/01	138.1	125.1	124.4	121.6	125.6	153	137.8	144.7
2001/02	142.1	127.7	125.8	123.9	135	156.1	143.5	146.4
2002/03	148.9	138.2	136.6	125.3	135.7	142.3	148.2	147.8
2003/04	154.8	139.8	138	126.1	140.3	148	158.3	150.4

Source: Rastra Bank

Base Year: 1995/96=100

*Table 13: Top 20 Public Expenditures by Sector 1999-2003*

Rank	Sector	Total by Sector (in millions- Rupees)	Share of Total
1	Education	60,800	15.21%
2	External Loan Payment	33,510	8.39%
3	Internal Loan Payment	32,590	8.16%
4	Miscellaneous	32,500	8.13%
5	Defence	29,060	7.27%
6	Police	27,030	6.76%
7	Electricity	25,470	6.37%
8	Road Transportation	22,950	5.74%
9	Local Development	21,870	5.47%
10	Health	18,450	4.62%
11	Irrigation	15,250	3.82%
12	Drinking Water	11,510	2.88%
13	Agriculture	11,400	2.85%
14	General Administration	10,420	2.61%
15	Forest	7,690	1.92%
16	Communications	6,774	1.70%
17	Constitutional Bodies	4,110	1.03%
18	Others-Social	4,046	1.01%
19	Industry	3,892	0.97%
20	Land Reform and Survey	2,961	0.74%
	Total	399,629	

Source: Author's Calculations from public expenditures data (World Bank 2007)

*Table 14: Irrigation Real Per Capita Expenditure by Geographical and Development Region*

Year	Expenditure Type	Geographical Region			Development Region				
		Hill	Mountain	Terai	Central	Eastern	Far West	MidWest	Western
1999	Total	5,198	2,753	4,166	3,735	1,674	1,421	2,801	2,486
	Recurrent	678	713	601	553	225	205	416	592
	Capital	4,518	2,040	3,564	3,180	1,449	1,215	2,384	1,894
2000	Total	4,872	4,079	6,603	4,237	3,494	1,445	3,293	3,085
	Recurrent	770	1,217	632	709	234	224	848	604
	Capital	4,100	2,860	5,970	3,529	3,260	1,220	2,443	2,479
2001	Total	4,175	2,444	4,942	3,504	2,478	1,028	2,494	2,057
	Recurrent	493	285	388	410	102	119	238	298
	Capital	3,681	2,159	4,554	3,094	2,376	909	2,256	1,759
2002	Total	3,803	1,155	3,854	3,012	1,326	972	2,187	1,316
	Recurrent	1,225	486	553	715	411	296	346	495
	Capital	2,578	670	3,301	2,298	914	676	1,840	821
2003	Total	4,671	1,240	4,043	3,909	1,282	1,071	2,238	1,455
	Recurrent	959	330	532	569	415	244	273	320
	Capital	3,712	910	3,511	3,340	867	827	1,964	1,135
Total	Total	22,719	11,671	23,608	18,398	10,254	5,937	13,013	10,398
	Recurrent	4,126	3,031	2,706	2,955	1,387	1,088	2,122	2,309
	Capital	18,590	8,639	20,900	15,441	8,865	4,847	10,888	8,087

Source: Author's Calculations from public expenditures data (World Bank 2007)

*Table 15: Agriculture Real Per Capita Expenditure by Geographical and Development Region*

Year	Expenditure Type	Geographical Region			Development Region				
		Hill	Mountain	Terai	Central	Eastern	Far West	MidWest	Western
1999	Total	5,622	4,136	1,005	3,259	2,189	579	1,819	2,916
	Recurrent	3,960	3,952	817	2,581	1,083	561	1,725	2,779
	Capital	1,655	169	181	674	1,102	16	85	128
2000	Total	6,581	6,088	1,328	4,163	2,003	1,033	3,134	3,664
	Recurrent	5,164	5,496	1,066	3,132	1,345	979	2,866	3,405
	Capital	1,408	573	255	1,028	648	51	256	252
2001	Total	8,085	5,958	1,396	4,736	2,867	969	2,643	4,223
	Recurrent	6,008	5,700	1,217	3,926	1,551	938	2,523	3,986
	Capital	2,077	258	179	810	1,316	31	120	237
2002	Total	5,411	5,613	1,188	3,424	1,363	986	2,822	3,616
	Recurrent	4,818	5,554	1,160	2,903	1,333	954	2,782	3,560
	Capital	593	59	28	521	31	32	40	56
2003	Total	5,516	5,893	1,292	3,255	1,344	1,327	3,099	3,676
	Recurrent	5,040	5,862	1,253	2,828	1,325	1,288	3,063	3,651
	Capital	476	31	38	427	19	39	36	25
Total	Total	31,215	27,688	6,209	18,837	9,766	4,895	13,517	18,096
	Recurrent	24,989	26,565	5,514	15,371	6,637	4,719	12,959	17,381
	Capital	6,209	1,089	682	3,460	3,116	170	536	698

Source: Author's Calculations from public expenditures data (World Bank 2007)

Table 16: Road Real Per Capita Expenditure by Geographical and Development Region

Year	Expenditure Type	Geographical Region			Development Region				
		Hill	Mountain	Terai	Central	Eastern	Far West	MidWest	Western
1999	Total	9,001	986	2,563	5,740	2,115	1,420	1,759	1,518
	Recurrent	491	44	229	311	128	107	123	95
	Capital	8,505	941	2,328	5,425	1,985	1,310	1,632	1,422
2000	Total	11,504	1,575	3,219	6,522	2,045	2,768	2,866	2,097
	Recurrent	610	75	259	383	150	160	141	111
	Capital	10,889	1,500	2,957	6,134	1,894	2,607	2,725	1,986
2001	Total	9,586	1,213	3,368	6,142	1,651	2,063	2,059	2,252
	Recurrent	755	80	319	451	216	184	158	145
	Capital	8,831	1,133	3,049	5,691	1,435	1,879	1,901	2,107
2002	Total	7,498	964	1,807	5,586	1,024	1,387	1,197	1,074
	Recurrent	670	73	298	413	202	161	136	129
	Capital	6,828	891	1,508	5,173	822	1,226	1,061	945
2003	Total	9,148	1,377	2,226	6,157	1,738	1,733	1,722	1,401
	Recurrent	651	65	288	412	189	155	125	123
	Capital	8,498	1,312	1,938	5,745	1,548	1,578	1,597	1,279
Total	Total	46,738	6,116	13,183	30,147	8,572	9,371	9,603	8,343
	Recurrent	3,177	338	1,393	1,970	885	767	683	602
	Capital	43,551	5,777	11,781	28,167	7,685	8,600	8,916	7,740

Source: Author's Calculations from public expenditures data (World Bank 2007)

Table 17: Access to selected facilities by expenditure quintile in Nepal 2003-4 and improvements since 1995-6

	Travel time in 2003-04 (mean hours)				Improvements since 1995-96 (percent)			
	School	Health Center	Paved Road	Market Center	School	Health Center	Paved Road	Market Center
Lowest	0.38	1.07	5.59	3.64	34	32	23	32
Second	0.3	0.88	5.5	2.72	17	38	5	17
Third	0.3	0.77	4.92	2.31	28	34	-5	20
Fourth	0.29	0.69	4.23	2.02	15	27	-3	18
Highest	0.18	0.45	1.71	1.05	31	36	27	27

Source: Nepal: *Resilience Amidst Conflict*, p 79

*Table 18: Road length in Nepal by construction and type 1995 and 2002 (kilometers)*

By construction type	1995	2002	Annual growth (percent)	By road type	1995	2002	Annual growth (percent)
Black top	3,533	4,781	4.4	Highway	2,831	3,029	1
Gravel	2,662	4,520	7.9	Feeder road	1,679	1,832	1.3
Earthen	4,529	7,534	7.5	District road	4,799	9,775	10.7
				Urban road	1,415	2,198	6.5
<b>Total</b>	<b>10,724</b>	<b>16,835</b>	<b>6.7</b>	<b>Total</b>	<b>10,724</b>	<b>16,835</b>	<b>6.7</b>

Source: *Nepal: Resilience Amidst Conflict* (2006), p 70.

*Table 19: Access to Govt. Extension Services*

	Agricultural Extension Advice	Veterinarian Extension Advice
Yes	5.57	13.7
No	94.43	86.3
Why not?		
Service Too Far	12.74	10.94
Poor Service	4.46	3.51
No Need	77.71	82.19
Other	5.09	3.36

Source: *Nepal: Resilience Amidst Conflict* (2006)

## Regression Results

*Table 20: Variable Abbreviations and Definitions in Regressions*

Variable Abbreviation	Variable Definition
conflict	number of conflict related killings by district
cons	consumption per capita
districtpop	district population 2001
distwages	average district wages
ethnicity	ethnicity of head of household
extension	received agricultural extension services
farmIncome	household farm income per capita
femaleheaded	household head is a female
foodprices	food price index
irrigation	type and size of irrigated plots
landelevation	highest and lowest district land elevations
landsize	non irrigated landholdings
locationofmigrant	location of migrant sending remittances
menwork	number of men in the household who work
rainfall	rainfall deviations from means
remittances	remittances per capita received by the household
traveltime	median traveltime by ward to market or agricultural cooperative
wageIncome	wage income earned per capita
womenwork	number of women in the household who work
zonedummies	geographic and development zone dummies

Table 21: Public Expenditures Patterns and Indicators of Conflict

In of total per capita spending in:	Irrigation	Agriculture	Roads
<i>Belt:</i>			
Hill	0.164 (0.071)**	-0.221 (0.056)***	1.305 (0.150)***
Terai	0.922 (0.120)***	-0.974 (0.094)***	0.784 (0.253)***
<hr/>			
Eastern	-0.834 (0.079)***	-0.108 (0.062)*	-0.723 (0.167)***
Central	-0.369 (0.079)***	0.376 (0.062)***	0.337 (0.167)**
Western	-0.475 (0.079)***	-0.046 (0.062)	-0.908 (0.166)***
Midwest	-0.085 (0.081)	0.114 (0.064)*	-0.65 (0.172)***
<hr/>			
Ln Total Conflict Deaths	-0.216 (0.030)***	-0.271 (0.023)***	-0.686 (0.063)***
Ln Population 2002	-0.201 (0.050)***	-0.282 (0.039)***	0.775 (0.105)***
Ln Brahman ethnicity share	-0.054 (0.026)**	0.139 (0.020)***	1.334 (0.055)***
Ln Difference in District Elevation	-0.004 (0.040)	-0.218 (0.031)***	-0.135 (0.085)
<hr/>			
Constant	9.898 (0.664)***	12.539 (0.522)***	-5.314 (1.403)***

Standard errors in parentheses

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

Omitted Belt: Mountain

Omitted Region: Farwest

Instrumented for all expenditures in regression

Table 22: District-level Benefits to Public Expenditure

District level production		Irrigation	Agriculture	Roads
<i>Effects of pooled spending (OLS)<sup>8</sup></i>				
Maize		NE	13.2%	1.69%
Rice		NE	12.3%	2.44%
Wheat		NE	NE	1.99%
Vegetables		NE	NE	NE
<i>Pooled Spending by Geographic Region (instrumented)</i>				
Maize				
	Mountain	NE	NE	5.81%
	Hill	NE	NE	4.13%
	Terai	NE	NE	NE
Rice				
	Mountain	NE	NE	NE
	Hill	NE	NE	NE
	Terai	NE	NE	NE
Wheat				
	Mountain	NE	NE	NE
	Hill	NE	NE	4.09%
	Terai	NE	NE	NE
Vegetables				
	Mountain	NE	NE	NE
	Hill	NE	NE	NE
	Terai	NE	NE	NE

<sup>8</sup> An IV approach produced no significant results.

Table 23: Estimating the Benefits of Rural Roads Using Jacoby's Approach

	Plot Value	
	1996	2002
ln( hours travel time)	-0.26 (0.013)***	-0.481 (0.013)***
ln( area in hectares)	0.529 (0.009)***	0.661 (0.009)***
khet	0.198 (0.035)***	-0.268 (0.030)***
<i>Irrigation</i>		
Seasonal	0.277 (0.058)***	0.157 (0.051)***
Year-Round	0.46 (0.066)***	0.236 (0.056)***
Canal	0.158 (0.058)***	0.225 (0.050)***
Tubewell	0.01 (0.083)	0.053 (0.064)
Constant	10.259 (0.104)***	13.004 (0.095)***
Observations	9783	8774
R-squared	0.55	0.6

Standard errors in parentheses

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

District Fixed Effects Included

*Table 24: Panel Data Model Results*

Benefit Incidence of Public Expenditure on Consumption per capita			
Panel Data: Outcome Variable	Irrigation	Agriculture	Roads
<i>Pooled Spending 1999-2003</i>			
Changes in Real Consumption per Capita	2.47%	.9%	3.57%
Changes in Real Agricultural Income	NE	NE	NE

*Table 25: Simultaneous Equations Model Results*

Simultaneous Equations (Lagged Spending)	Marginal benefit per unit of investment	Marginal investment per unit of expenditure	Overall Effect
Roads	0.1164	0.260	30.25%
Canal Irrigation	0.0600	0.160	9.61%
Ag. Extension	0.0303	0.045	1.36%
Fertilizer	0.0166	0.180	2.98%

Table 26: *Summary of Returns to Irrigation, Agriculture and Road Expenditures*

<i>Outcome Variable</i>	<i>Data</i>	<i>Methodology</i>	Irrigation	Agriculture	Roads
Maize Profits	District level data	Instrumental variable	NE	14.85%	4.39%
Rice Profits	District level data	Instrumental variable	NE	13.84%	6.34%
Wheat Profits	District level data	Instrumental variable	NE	NE	5.17%
Vegetables Profits	District level data	Instrumental variable	NE	NE	NE
Plot values	Cross-sectional household data	Jacoby approach	16.62%-36.86%	NA	26.41%-60.78%
Consumption per capita	Panel data	Instrumental variable	3.92%	.92%	6.43%
Agricultural Income per capita	Panel data	Instrumental variable	NE	NE	NE
Consumption per capita	Cross-sectional household data	Simultaneous Equations	9.61%	1.36-2.98%	30.25%

NE= No Effect

NA=Not Applicable