Socio-economic Impact of National Highway on Rural Population

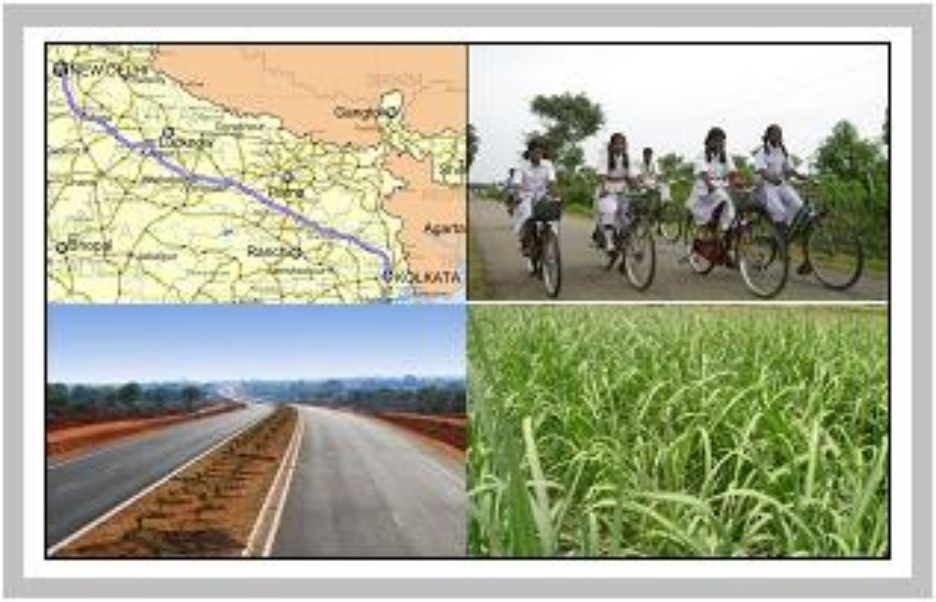

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Table of Contents

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Abbreviations

AFC	:	Average Fixed Cost
AIOPL	:	All-India Official Poverty Line
AVC	:	Average Variable Cost
BDO	:	Block Development Officer
BLUE	:	Best Linear Unbiased Estimator
BPL	:	Below Poverty Line
CBA	:	Cost Benefit Analysis
CGE	:	Computable General Equilibrium (Model)
CPIAL	:	Consumer Price Index for Agricultural Labour
CPIMR	:	Consumer Price Index for Middle-range Rural Population
CPIMU	:	Consumer Price Index for Middle-range Urban Population
CPITR	:	Consumer Price Indices for Total Rural Population
CPITU	:	Consumer Price Indices for Total Urban Population
CSO	:	Central Statistical Organisation
CV	:	Co-efficient of Variation
DRDA	:	District Rural Development Agency
EC	:	Encompassing Communities
FSU	:	First Stage Unit
GDI	:	Gender-related Development Index
GDP	:	Gross Domestic Product
GEM	:	Gender Empowerment Measure
HDI	:	Human Development Index
HPI	:	Human Poverty Index
IAY	:	Indira Awas Yojna
ICMR	:	Indian Council of Medical Research
ILO	:	International Labour Organisation
IRDP	:	Integrated Rural Development Programme
IWW	:	Institute for Economic Policy Research (University of Karlsruhe, Germany)
JRY	:	Jawahar Rozgar Yojna
LRMC	:	Long Run Marginal Cost
LUTI	:	Land-Use/Transport Interaction
MGNREGA:		Mahatma Gandhi National Rural Employment Guarantee Act
MPCE	:	Monthly Per Capita Consumption Expenditure
MPCY	:	Monthly Per Capita Income

MRA	:	Multivariate Regression Analysis
NAS	:	National Accounts Statistics
NDC	:	National Development Council
NH	:	National Highway
NMT	:	Non-motorised Transport
NPRT	:	Non-parametric Regression Technique
NRA	:	Non-parametric Regression Analysis
NSS	:	National Sample Survey
NSSO	:	National Sample Survey Organisation
OAE	:	Own Account Enterprise
ODA	:	Overseas Development Administration
OLS	:	Ordinary Least Square
PCTE	:	Per Capita Total Expenditure
PCTR	:	Per Capita Trip Rate
PHC	:	Primary Health Centre
PL	:	Poverty Line
PRA	:	Participatory Rural Appraisal
PSMT	:	Propensity Score Matching Technique
RTS	:	Rural Transport Services
RTTS	:	Rural Travel and Transport Survey
SACTRA	:	Standing Advisory Committee on Trunk Road Assessment
SC/ST	:	Scheduled Castes and Scheduled Tribes
SEM	:	Simultaneous Equation Model
SJSY	:	Swarna Jayanti Swarozgar Yojna
SW	:	Social Welfare
TFP	:	Total Factor Productivity
TRT	:	Trasporti e Territorio Srl (Milano, Italy)
UTs	:	Union Territories
VLSS	:	Vietnam Living Standard Survey
WFPR	:	Workforce Participation Rate
WPI	:	Wholesale Price Index
WPR	:	Worker Population Ratio

Executive Summary and Main Findings

1. India has embarked upon a programme of upgrading of its national highway network, initially connecting the four metropolises and major maritime ports. This programme requires massive investments. Side by side, the country also carries a crushing load of poverty, which is more pronounced in the rural areas. According to the latest estimates, more than one-third of its rural population lives below the poverty line.

2. The existing level of understanding of the causal relationship between transport infrastructure and human 'well-being' in general and poverty in particular, is inadequate. Most of the evidence in this regard is anecdotal and not based on empirical results. Whilst transport is accepted as an important element in both direct and indirect intervention for poverty reduction, there has so far been little attempt at formal accounting of poverty in transport projects.

3. In the literature related to the impact analysis of road-related projects, there are references to studies of the socio-economic impact of rural roads. But there is virtually no discussion of the impact of a highway, particularly a major national trunk route. The role of a major highway has been mainly evaluated in traditional terms of moving intercity passenger and freight traffic. Its socio-economic impact on the rural population living in its proximity has never been studied.

4. Over time, perceptions of poverty have also undergone a significant change. It is no longer just monetary income that determines the poverty levels. There are other dimensions as well. Poverty is now viewed as a level of deprivation of access to means of attaining one's potential as a human being physically and intellectually. Thus, facilities like water, sanitation, connectivity, and educational and medical services are also recognised as important indices of human development.

5. Typically, investment projects in the transport sector are evaluated by cost-benefit analysis (CBA) primarily in terms of efficiency considerations. The method is, however, not even-handed in all cases. It tends to favour investment in high-return projects. Besides, there are many items where cost-benefits are not readily quantifiable and therefore do not get adequately reflected. There are also issues of market imperfections and externalities not captured in the conventional CBA.

6. The growing concern for poverty alleviation has led to a re-examination of the adequacy of the existing project evaluation criteria in assessing the distributional impacts. The socio-economic impact analysis, therefore, aims at assessing the magnitude and distribution of both direct and indirect effects of a project. Keeping all this in view, it was decided to undertake an evaluation of the socio-economic impact of four-laning of a stretch of a national highway being four-laned on the rural population living in its proximity.

7. For this, a long stretch of national highway (NH2) covering a distance of 995 km between Agra and Dhanbad, falling in the states of Uttar Pradesh, Bihar and Jharkhand, was selected. The issue of poverty alleviation is more pertinent and relevant in respect of this stretch because most of the areas contiguous to it have a high incidence of rural poverty. This has also been confirmed by the census conducted by the state governments concerned for identifying the rural poor for coverage under various poverty alleviation programmes.

8. The measurement of the impact of an existing road or that of a road-related project – be it a new road or widening or upgrading an existing one – is generally beset with a number of problems. Such problems are specific to this kind of projects, not normally encountered in most other public investment projects. It is essentially because a road-related project generally has a number of unique features.

9. Firstly, since the various services of a road together form a public good, by definition is non excludable and non-rivalrous, identifying the beneficiary/ participating population in a road-related project is not simple. Secondly, the impact of a road-related project often tends to get confounded by the impact of other interventions on the outcome variables. Finally, the conceptual and methodological issues in the impact measurement of a road that already exists or has been improved (by widening, say) may be somewhat different from those arising in the case of the impact analysis of a new road.

10. The impact of a road (a new one or an upgraded one) consists of direct or first-round effects, and indirect or a sum total of all later-round effects. Direct effects are mostly observed in the form of increased mobility, reduced travel time, etc. The indirect effects, on the other hand, consist of structural changes in the economy due to enhanced opportunities which would result from increase in mobility arising from the development of infrastructure.

11. An economic-theoretic framework has, therefore, been developed to explain why and how a road or its improvement is expected to affect the well-being of people living around it. The model justifies using variables related to mobility and socio-economic well-being as relevant outcome variables, examining the relationship of each of these variables with the distance from the highway, and delineating the influence zone of the project.

12. An important issue in assessing the impact of a road or its expansion is the identification of the influence zone, i.e., the area on either side of the road to which the impact is supposed to be limited. Based on considerations of accessibility and connectivity, this zone has, *a priori*, been delineated to be the area lying within a distance of 5 km on either side of the chosen segment of NH2. This means the distance that can be travelled in less than 30 minutes on a bicycle or in one hour on foot.

13. The areas lying on both sides of the highway beyond the approach distance of 5 km and within the horizontal distance band of 7 km have been treated as the control zone. This is on the presumption that the socio-economic benefits decline sharply as the distance exceeds 5 km. The control zone enables comparison with the influence zone for the purpose of assessing the net socio-economic impact of the project. This comparison is done under two situations – before and after the implementation of the project – so as to isolate the effects of other simultaneous development initiatives or processes.

14. Typically, benefit analyses comprise two studies of socio-economic conditions – one based on baseline survey data (collected before the project is launched) and the other based on re-survey data (collected after the project has been completed). The *partial* effects of the project are then assessed by appropriately comparing the results of these two studies. The current report presents the results based on the baseline and the re-survey data.

15. The methodology of impact assessment makes use of four statistical/econometric techniques, viz., correlation analysis, comparison of means, propensity score matching technique (PSMT)-based single difference analysis (SDA) and double difference analysis (DDA) and non-parametric regression analysis (NRA). The conventional regression modelling and the more sophisticated PSMT-double difference method are not substitutes for each other, but rather serve as

complementary exercises where one seeks to corroborate and improve the results in the overall framework.

16. The methodology adopted having a strong theoretical underpinning helps to ensure robust empirical results. Compared to conventional evaluation techniques like cost-benefit analysis or simulation based on the computable general equilibrium model, or the econometric technique of simultaneous equations model, this methodology is considered to be more operational, reliable and far less expensive.

17. The statistical/econometric techniques have been supplemented by participatory rural appraisal (PRA), which, *inter alia*, includes reflexive or generic controls. In reflexive comparisons, the participants themselves provide the control information by comparing themselves 'before' and 'after' receiving the intervention. With generic comparisons, the impact of the intervention on beneficiaries is compared with established norms about typical changes occurring among the target population.

18. The full impact study of the widening of NH2 requires pre- and post-project household and village level data in respect of possible outcome variables. The impact assessment has, therefore, been set up in two stages and relies primarily on survey-based collection of data and quantitative analysis of such data. The relevant universe comprises all households living in villages belonging to the defined influence and control zones of the selected stretches of NH2.

19. The area of this universe comprises seven stretches spanning the three states of Uttar Pradesh, Bihar, and Jharkhand. The representative stretches have been chosen on the basis of agro-climatic and other macro features, in particular, the incidence of poverty. In these selected stretches, 1,697 villages lying in the horizontal distance band of 0-7 km on both sides of NH2 have been identified. It may be clarified that the concept of horizontal distance is different from that of approach distance. Thus, the horizontal distance band of 7 km may include villages whose actual approach distance may be much higher, extending up to 16 km.

20. The sample design adopted for each of these stretches is a stratified two-stage one – villages being the first stage and households the second stage. The first stage sample units have been selected using the probability proportional to size (PPS) without the replacement technique, and those in the second stage have been selected by using the circular systematic sampling technique. The sample covers 200 villages

and 3,200 households both in the baseline and follow-up surveys. However, due to expected time-related attrition only 3071 households could be covered in the resurvey.

21. In order to generate data on village and household characteristics, as well as different socio-economic causal factors and outcomes of the developmental intervention of the highway, extensive schedules were prepared for the primary baseline survey conducted in 2002-03. The baseline survey was followed up by post-project survey in 2009-10. The list of variables covers, among others, transport connectivity; mobility patterns; incidence of poverty; income, employment and occupation; asset ownership; education and health facilities; and attitudinal response.

22. The temporal changes, as revealed by the baseline and the resurvey data sets, have been analyzed. The summary profiles provide contextual underpinning for assessing the socio-economic impact of making the national highway four-lane. Since the time-gap between the two surveys is seven years and not long, any observed improvement in indicators may *partly* be ascribed to the NH2 upgrading. The profiles also help to see if any positive impact of NH2 upgrading has been progressive, socially inclusive and spatially even-distributed.

23. The profiles clearly bring out a distinct structural shift in the rural economy in terms of an increase in non-farm activities, higher workforce participation, an increase in school enrolment and better literacy levels. There is a noticeable increase in female participation in the workforce as also the school enrolment of girls. These beneficial changes help in the empowerment of women, a development of considerable importance for the country.

24. Mobility levels have also risen across all the income classes in terms of increases in per capita weekly trip rates as well as trip lengths. This is a clear indication of improvement in job opportunities and access to markets, schools, and other services. This is also a sign of increase in the spatial distribution of economic activities.

25. Economic growth and development have been widespread and largely inclusive. However, the effects of such development have not been uniform across time or across economic classes. Although the differences have remained they have substantially narrowed. With Bihar and Jharkhand showing greater improvement, the disparities there have considerably reduced.

26. The non-poor or not-so-poor have benefitted more than the poorer ones. This is perhaps typical of the early days of development as better-off persons have better access to facilities. As time goes by, it can be expected that benefits would become more even.

27. Human dignity depends to a great extent on education. Labour productivity in the long run is also a function of the levels of schooling received. Average school enrolment among children has increased to more than 90 percent. Significantly, the enrolment level among the poor households has also been high – 86 percent. Furthermore, Bihar and Jharkhand have shown considerable improvement in this regard. All these developments have long-term beneficial implications.

28. The overall literacy level has improved across all the stretches, but it is still somewhat lower than the national average. The interstate and class differences also persist. For example, for the poor households, literacy is 17 percent less compared to the non-poor households. However, the female literacy rate among the poor households has increased at a much faster rate than the non-poor households which is a welfare improvement.

29. It is now well-established that the individual and social returns from the women's education are exceptionally high, especially in the matter of lowering of fertility and infant and child mortality rates, and improvement in the children's educational achievements. There has been a significant rise in school enrolment among girls even in poor households. In this respect, both Bihar and Jharkhand have done well.

30. The proportion of working women in the total female population has registered a manifold increase across all economic classes, with Bihar and Jharkhand registering higher increase. Generally, the female workforce participation rates are higher in poor households. This position has undergone a dramatic change. The women from not-so-poor households are also equally participating in the workforce.

31. The overall sex ratio (number of females per 1,000 males) has remained unchanged and continues to be lower than the national average. The poor households have a higher sex ratio than the non-poor households. Arguably, better-off communities have a stronger gender bias against the female than poor households.

32. In terms of poverty indicators, the proportion of people living below the poverty line has declined significantly for all the stretches except Auraiya in Uttar Pradesh both on an overall basis and headcount basis. For scheduled castes and scheduled tribes, this proportion has also reduced for all the stretches except at two places in Uttar Pradesh, viz., Auraiya and Firozabad, both on an overall basis and headcount basis.

33. The average landholding per household is low at 0.63 hectare, with marginally higher holdings in Bihar and Jharkhand. There is pronounced disparity in resource endowments across the economic classes. The average landholding of a poor household is abysmally low – one-eighth of a hectare in Uttar Pradesh and a quarter of a hectare in Bihar and Jharkhand. The non-poor households are better off, particularly in Bihar and Jharkhand with an average landholding of 0.98 hectare.

34. The share of income from agriculture particularly in Bihar and Jharkhand has increased but the number of households engaged in agricultural activities has gone down in all the representative stretches. The poor households have a smaller share of income from agriculture in comparison to the non-poor households. However, in case of poor households, their share from non-agricultural activities has increased.

35. The rationale of the present study is based on the premise that, *ceteris paribus*, access to a highway provides to the population living in its appropriately defined neighbourhood opportunities that help improve their well-being. To verify this presumption empirically on the basis of village-level data, the relationship between selected village-level indicators of socio-economic well-being and the proximity of villages to NH2 has been examined, using different statistical/econometric techniques.

36. The empirical results firmly confirm that proximity to highway has a positive relationship with: (i) demographic characteristics (density of population), (ii) proportion of BPL households (iii) share of motorised transport, (iv) employment in non-farm activities (proportion of non-agricultural workers in total main workers), (v) housing conditions (proportion of semi-pucca and pucca houses in the total number of dwellings), (vi) enrolment of students and also that of girl students, and (vii) price of land (price of irrigated crop land and residential land).

37. The results of non-parametric regression analysis of the follow-up survey dataset have confirmed that for most of the chosen indicators, there is a desired shift

of the level of the curve in relation to the baseline NRA curve. More importantly, in many cases, the gradient of the relationship shows a marked change around a distance level of 4-5 km, indicating that the effect of the highway on villages located within this approach distance is qualitatively different from that on villages at greater distances.

38. The improved job opportunities available in closer proximity to the highway have a significant influence on the demographic characteristics in terms of higher density of population in the nearby villages. In particular, the relatively poor tend to stay closer to the highway because of better job prospects in non-agricultural activities and ease of commuting. This phenomenon has implications for interpreting the gradient of change.

39. The basic premise underlying the household-level data analysis, as in the case of analysis of village-level data, is that proximity to NH2 would help improve a household's well-being. An improved road infrastructure, in turn, would further enhance the well-being of the population. Given that the notion of socio-economic well-being is essentially multi-dimensional, a wide array of household-level outcome variables (that are likely to reflect the well-being of the population) have been analysed to assess if proximity to NH2 leads to significant differences in the level of these variables and also to explore the nature of relationship these variables may have with the distance from NH2.

40. The results clearly suggest that proximity to NH2 has a significant relationship with (i) transport and mobility (per capita trip rate, per capita trip rate for work, per capita trip rate involving travel on NH2, per capita trip length for trips involving NH2, per capita travel time for trips involving NH2, travel cost per person km for trips involving NH2), (ii) extent of income and employment in non-farm activities (share of income from self-employment in non-agricultural activities, female labour participation, proportion of non-agricultural workers in total working household members), (iii) asset holding (whether a household owns at least one information related consumer durable), and (iv) health attainment (proportion of household members who availed of medical facilities during the last six months).

41. Proximity to NH2 and its upgrading has significant beneficial influence on many aspects of household well-being especially those relating to mobility and non-

agricultural employment, thereby signalling significant structural changes in the local economies of the neighbourhood of the highway.

42. The beneficial influence systematically declines as the distance from the highway increases, thus empirically supporting the gradient change hypothesis. The influence zone generally extends up to a distance of 4-5 km on either side of the highway. There are, however, some evidences of the expansion of the influence zone beyond this distance slab.

43. Post-upgrading shifts of the NRA curves have mostly been in the expected direction. This, however, is only suggestive of the positive impact of NH2, as NRA analysis brings out the total temporal shift of the relationship of an outcome variable with distance from NH2 rather than the partial shift due to upgrading. The measured impact of NH2 upgrading based on PSMT-based double differences is in the expected direction for majority of the outcome variables, including those for which re-estimation based on 6 km delineation of influence zone gave expected results.

44. The presumption of temporal fixity of the delineated influence zone required for impact measurement based on double difference needs careful attention. It is, however, realized that a clinical divide of influence zone-control zone for impact assessment is not possible.

45. The impact of proximity to NH2 has also been analysed for two well-being indices: (i) Index of overall well-being based on income, employment, health and education; and (ii) Index of access to infrastructural facilities, assets and amenities. These indices have been constructed on the line of Human Development Index (HDI). Both the indices show favourable shift in the curve as compared to baseline scenario.

46. In addition to the above, rural road transport and travel-related issues have been separately analysed to understand the infrastructure related accessibility status and mobility patterns of the population. The access of villages to various social and physical infrastructure facilities has also been examined. It covers the ownership pattern of different types of vehicles and availability of public transport facilities.

47. Rural road transport and travel-related issues have also been discussed in two other chapters of the report. The issues relating to the mobility of the poor and

disadvantaged population have been dealt with in Chapter 3. The relationship between mobility and defined well-being indicators has been examined in Chapter 5.

48. The connectivity issues in relation to the national highway have also been studied besides finding out the extent of access of the villagers to various social and physical infrastructure facilities. The relationship between mobility and defined 'well-being' indicators has been examined while carrying out the impact analysis of the highway at the household level.

49. The study shows that, contrary to the traditional view that a national highway primarily facilitates intercity travel and transport of goods, the study has shown that it is also an important and integral part of the road network serving rural areas. This is borne out by the fact that almost 50 percent of the total trips originating from the selected villages involve the use of the national highway.

50. This brings out the need for building service roads along the highways for slow-moving traffic – pedestrians, cyclists, bullock carts, etc. Equally important is the safe design of road crossings between highways and village roads. A large number of villages are connected to the highway by kutcha roads. The upgrading of these roads would then enable the realization of full potential of the highway.

51. Overall, the levels of mobility have shown a marked increase of 60 percent – 8.7 trips a week as compared to 5.49 in the baseline survey. More trips are being undertaken for visiting mandis, markets, and for work, education and health. This development alone underscores the importance of the growing local economies.

52. Bicycles account for over 76 percent of the total number of vehicles owned by the households. This share was 87 percent at the time of the baseline survey. The share of motorised vehicles has doubled from 8.6 percent to 16 percent. Among the motorised vehicles, two-wheelers – scooters and motorcycles – predominate. The share of motorised vehicles is found to be higher in the vicinity of the highway.

53. Most trips are made on foot or by bicycle and two wheelers. However, the number of trips on foot has declined. The average trip length continues to be relatively short with more than half the trips being undertaken within a distance of 5

km. This finding in a way corroborates the hypothesis of delineating the influence zone of 5 km.

54. The empirical studies convincingly document and confirm that, among other interventions, large-scale public investments in road infrastructure development can also be an effective and viable policy measure for improvement in the well-being and qualify of life of the rural population.

Main Findings and Policy related Lessons

Proximity to the highway has significant influence on major aspects of socio-economic well-being of the rural population. Greater opportunities of employment and earnings in non-farm activities are generated. Access to education and health facilities improves. Household incomes rise and so do asset holdings. Poor rural households living in its vicinity thus also derive considerable benefits.

The benefits of the highway mostly extend up to a distance of 4-5 km on its either side, which may be treated as the influence zone. There are, however, some evidences of the expansion of the influence zone beyond this distance slab for a few outcome variables. Improvement in mobility is likely to facilitate this process over a long period.

The impact of the highway generally declines as one moves farther away from it. A poor household residing in the influence zone is better-off in terms of various indicators of well-being vis-à-vis a comparable household living away from the influence zone.

The immediate net benefits of the upgraded highway mostly relate to improvement in access to work and educational opportunities. This is borne out by: three-fold increase in the share of income from non-agricultural activities; 85 percent increase in female labour participation; two-fold increase in per capita trip rate for education; and about 50 percent increase in school enrolment.

In the long-run, the net benefits are most likely to emerge in other aspects of well-being as the role of the four-lane highway becomes more relevant for the rural population living in its proximity. Greater economic opportunities will arise and *pari passu* the proximity gains will increase, spilling over to even longer distances.

The temporal shifts in the level of well-being, as revealed by the pre and post project surveys, indicate strong and mostly inclusive growth impulses in the economy. The post-project analysis has shown improvement in almost all aspects of household well-being including poverty reduction. The benefits are, however, not uniformly spread either spatially or across economic classes. The differences have remained but have substantially narrowed.

There has been a distinct structural shift in the rural economy in terms of an increase in non-farm activities, higher workforce participation, an increase in school enrolment and better literacy levels. There is a noticeable increase in female participation in the workforce as also the school enrolment of girls. These beneficial changes help in the empowerment of women, a development of considerable importance for the country.

Contrary to the traditional view that a national highway mainly facilitates intercity travel and transport of goods, the results firmly bring out that it is also an integral part of the road network serving the rural areas. This is borne out by the fact that almost 50 percent of the total trips originating from the selected villages involve the use of the national highway.

Policy related Lessons

The empirical studies convincingly document and confirm that, among other interventions, large-scale public investments in road infrastructure development can also be an effective and viable policy measure for improvement in the well-being and qualify of life of the rural population.

The extensive use of the national highway by the rural population for their social and work-related trips brings out the need for building service roads along the highway to cater to the slow moving traffic comprising pedestrians, cyclists, bullock carts, etc. Equally important is the safe design of road crossings between highways and village roads.

Introduction

Since the early days of civilisation, conditions under which man lives are largely shaped by the ease and speed with which he is able to move himself and his goods. Transport affects the daily lives of people in its myriad forms. It influences the nature and pace of economic development, population distribution, the shape of cities, energy consumption, access to markets and materials, and the pace, style and quality of life. At the same time, it provides employment to millions of people.

Thus, transport and economic development are interdependent, but their relationship is both complex and dynamic. There is a positive feedback loop wherein transport energises economic activity by facilitating the movement of persons and goods which, in turn, leads to a greater demand for transport. This two-way interaction tends to relocate industries, services and labour and thereby helps shape the economic geography of a country. Indeed, the great visionary of economics, Adam Smith visualised that by providing greater access to markets, transport would bring about the specialisation and division of labour and thus foster the process of economic growth.

The ultimate aim of any economic activity, including the development of transport infrastructure, is to promote human welfare. However, due to an array of reasons like the pattern of the existing socio-economic structure, geo-political and historical factors, benefits of development are not shared equitably. A variety of distributional inequalities therefore show up at all levels, be it local, regional, or global. A large part of society often receives little or none of the benefits of development. This segment consists of the poor who mostly live in the rural areas of the developing world.

The post-Second World War period saw a great deal of conscious effort to achieve economic development. New institutions were set up to deal with the emerging political and economic architecture. In the early phase, the approach towards economic development was rather straightforward: it was thought that a self-sustaining process of growing gross national product could be started through a proper allocation of resources across sectors in an economy and, in due course of time, it would bring in prosperity for all, notably the poor. Thus, the thrust was essentially on capital formation and investment and the ordering of alternative investment plans in

terms of their efficiency implicit in economic returns and selecting the investment(s) that would be most productive in terms of surplus generation.

Accordingly, methodologies were evolved for a better measurement of national income, on the one hand, and selection of investment projects, on the other. For the latter, mainly direct costs and benefits would be enumerated and measured for the purpose of project evaluation. Projects for which the expected benefits outweighed the expected costs would be regarded as viable and hence fit for implementation, resources permitting. With the passage of time and accumulation of experience, more and more sophisticated techniques were introduced in this art of project selection. These related to the method of quantification of intangible social costs, costs of possible externality of a project to the economy, shadow pricing, internal rate of return, and so on.

Project evaluation based on cost-benefit analysis became a routine feasibility exercise across the board, including projects relating to the transport sector – a road, a railway line, or an airport. However, despite its sophisticated nature, shortcomings of the method for evaluating the projects started getting noticed soon. For instance, the method would inherently favour the construction/development of urban, high traffic-density roads, because in this case not only the pure economic return would often be much higher, the urban population would have a greater ability and willingness to pay. The method would disfavour investments in low-traffic rural areas since it would not capture some important but hard-to-quantify benefits often generated by such roads.

In the seventies, the debate thus centred around altering the methodology while evaluating rural road projects. The case for a change rested on the need to incorporate in the cost-benefit calculation the value of induced agricultural developmental impacts that a rural road development would trigger by facilitating transportation. However, even when such impacts are taken into consideration, the method remains partial, as it ignores the impact on non-farm employment, other income opportunities, and improvements in important social aspects of well-being.

Further attempt was made to correct the inherent bias by using distributional weights. This effort could also not meet approval on several grounds. First, the distributional concerns, if any, have to be handled directly at the macro-economic

level through the instruments of a tax-subsidy mechanism. Secondly, income distribution decisions often involve value judgement issues that are essentially political responsibilities. Lastly, the use of distributional weights is vulnerable to misinterpretation and open to manipulation.

Over time, perceptions of poverty have also undergone a quantum change. The phenomenon of absolute poverty is no longer viewed as the issue of a person or a household living below or above a threshold poverty line of per capita income or consumer expenditure identified as the poverty line. Today, poverty is understood as a multifaceted phenomenon reflecting deprivations in several respects like food security, shelter, health and education, command over productive assets, access to employment and earning opportunities, and so on. To put it differently, poverty is viewed as a major obstacle to attaining one's potential as a human being, physically and intellectually. That is why access to socio-economic infrastructures like availability of potable water, sanitation, connectivity and communication, educational and medical facilities are also recognised as important ingredients of human development.

The concerns about poverty in its multidimensional form in the context of impact evaluation of public investment projects would call for two things. First, a set of indicators of well-being that would sufficiently reflect the socio-economic status of the population connected with a project needs to be identified. Then, the causal link between these indicators and economic development in general and the implementation of a project in particular has to be established conceptually and empirically. Needless to mention that a firm causal link between the two would mean that sizeable public investment for transport sector improvement might serve as an effective instrument for poverty lessening and overall improvement in the well-being of the rural poor population.

The general impact of transport sector projects has hitherto been assessed essentially using the conceptual framework of a general equilibrium model. In this framework, the transport sector is taken as one of the sectors, albeit a major one, of a country's economy, and the backward and forward linkage effects of a specific transport sector investment project on the economy are enumerated and valued. Whilst transport is an important element in both direct and indirect intervention for poverty reduction, there has so far been little attempt at formal accounting of poverty

in transport projects. This is because of the prevalent supposition that distributive equity is an issue to be tackled by fiscal measures like taxation.

Accordingly, a methodology of appraisal, viz., the socio-economic impact analysis incorporating distributional issues is being evolved for such projects. This analysis essentially aims at assessing the magnitude and distribution of both direct and indirect effects of a project. A recent World Bank study has attempted to formulate the issues involved in this regard specifically for road projects in the rural areas. The study also suggests an econometric technique for isolating the impact of the road and lists a host of potential variables for this purpose. The study, however, ends with a word of caution that the design and administration of analysis would be complex and costly and hence practical considerations will have to prevail.

In the literature related to the impact analysis of road-related projects, there are references to studies of the socio-economic impact of rural roads. But there is virtually no discussion of the impact of a highway, particularly a major national trunk route. The existing level of understanding of the causal relationship between transport infrastructure and human 'well-being' in general, and poverty in particular, is also quite inadequate. Most of the evidence in this regard is anecdotal and not based on empirical results. The role of the highway has been mainly evaluated in traditional terms of moving intercity passenger and freight traffic.

India has embarked upon a programme of upgrading its national highway network, initially connecting the four metropolises and major maritime ports. This programme requires massive investments. Side by side, the country also carries a crushing load of poverty, which is more pronounced in the rural areas. According to the latest estimates, more than one-fourth of its rural population live below the official poverty line. It was, therefore, decided to undertake an evaluation of the socio-economic impact of a stretch of a national highway proposed to be upgraded to a four-lane status on the rural population living in its proximity.

For this, a long stretch of national highway covering a distance of 995 km between Agra and Dhanbad, falling in the states of Uttar Pradesh, Bihar and Jharkhand, was selected. The issue of poverty alleviation is more pertinent and gains greater importance in the case of these states because most of the areas contiguous to it have a high incidence of rural poverty measured according to the official poverty

line. This has been further confirmed by the census conducted by the state governments concerned for identifying the rural poor for covering them under various poverty alleviation programmes.

This study, which is perhaps the first of its kind, was faced with many challenges. These included building the required conceptual and theoretical framework, designing the baseline and post-project household surveys for the collection of relevant data, selecting the set of outcome variables, evolving an appropriate methodology of analysis and, last but not the least, estimating the impact of four-laning of NH2 on the set of chosen outcome variables.

Typically, socio-economic impact evaluation of a public investment project requires two sets of information on the relevant set of variables – a set of pre-project information collected through a baseline socio-economic survey and a corresponding set of post-project information gathered through an endline socio-economic survey. The effects of the project are then assessed by appropriately comparing these two sets of information.

The socio-economic impact of living in the proximity of the given stretch of national highway based on the baseline survey data has already been studied and the results of that study are presented in the first report (AITD, 2003). The present report is the final report of the project on the socio-economic impact evaluation of four-laning of the given stretch of national highway. It presents, along with other details, empirical results relating to the socio-economic impact of upgrading the selected stretch of the highway by four-laning.

The present report is structured as follows. Chapter 1 lays down the economic-theoretic framework and a methodology for evaluating the road impact on the well-being of the rural population. It also describes the use of statistical and econometric techniques for isolating the impacts from a host of other factors. Chapter 2 comprises a discussion of the survey structure and methodology, identification of representative stretches, sample design, etc. The base-line survey covered 200 villages and 3,200 households spread over 73 blocks, 21 districts, and 3 states, involving an extensive fieldwork in the interior of the countryside while the endline survey involved a resurvey of the sample villages and households covered in the baseline survey.

However, due to attrition, 3071 households could be finally covered in the endline survey.

Chapter 3 analyses the socio-economic profile of rural households separately for the poor and the non-poor. This examination, carried out perhaps for the first time in the country, helps to understand better the distributive impacts on different income groups. At the same time, it provides a comparative regional perspective.

Chapters 4 and 5 present the estimates of the impact of the highway on the set of chosen outcome variables at the village and household levels. This estimation shows the relationship between these variables and the distance from the highway. In the process, it also establishes a gradient-of-change hypothesis for most of the variables. More importantly, it validates the concept of defined influence zone of the highway.

Chapter 6 studies the rural road transport and travel-related issues to understand the accessibility status and mobility patterns of the population. The connectivity issues in relation to the national highway have also been studied, so also the extent of access of the villagers to various social and physical infrastructure facilities. The relationship between mobility and defined well-being indicators has been examined while carrying out the impact analysis of the highway at the household level.

Chapter 1

Methodology of Impact Evaluation

The socio-economic impact analysis of a public investment project is done to assess the extent of net socio-economic benefits of the project that accrue to the population group(s) concerned, with the object of achieving poverty alleviation and improvement in socio-economic condition. Typically, such analyses comprise two studies of the socio-economic condition of the concerned population group(s) – one based on baseline survey data (collected before the project was launched) and the other based on endline survey data (collected after the project has been completed). The partial effects of the project are then assessed by appropriately comparing the results of these two studies.

The measurement of the impact of an existing road or that of a road-related project – be it a new road or widening or upgrading an existing one – is generally beset with a number of problems. Such problems are typical of this kind of projects, and are not normally encountered in case of most other public investment projects. It is essentially because of a number of unique features that a road-related project generally has.

Firstly, since the various services of a road together form a non-excludable public good, defining the beneficiary/participating population in a road-related project is not simple[1]. As we shall see later, defining beneficiary population for a road-related project is difficult due to a host of other reasons as well. Secondly, the impact of a road-related project often tends to get confounded by the effects of other interventions on the relevant impact (i.e. outcome) variables[2]. That makes the measurement of the partial effects of such a project a challenging proposition. Thirdly, in the case of a road-related project like the present one, which involves massive investment, apart from the partial and localised impact, strong economy-wide (general equilibrium) effects are often generated. These are also, no doubt, important, but analysing them

1. Two things may be noted in this context. First, even when access to a road is controlled, say, through a toll, the population living in an appropriately defined neighbourhood of the road will derive non-excludable net benefit due to the presence of the road in their neighbourhood. Secondly, unlike in cases of welfare programmes like, say, participation in a food for work programme, no direct/formal participation of individuals/households is involved in the case of a road project and, therefore, participation is not voluntary.
2. Henceforth, we shall use the words ‘impact variables’ and ‘outcome variables’ interchangeably to mean the variables based on which the socio-economic impact is being measured.

may require technique(s) and information that may be widely different from those required for an impact analysis. Finally, the conceptual and methodological issues in the impact measurement of a road that already exists or has been improved (by widening, say) may be somewhat different from those arising in the case of the impact analysis of a new road.

Given the distinguishing features of a road-related project mentioned above, evolving an appropriate impact analysis procedure would normally call for an economic theoretic framework as well as resolving some important conceptual and methodological issues. The former should explain why and how a road or its improvement is expected to affect the well-being of the population concerned. The latter, on the other hand, centres around the question whether the pure partial effect of a road or its improvement on the chosen set of outcome variables can be segregated and measured. This question arises because the variables in question may be affected by factors of which the road may be just one, albeit a major one.

In this chapter, the various conceptual and methodological problems that arise in the context of the impact analysis of a road-related project are elaborately discussed. First, an economic-theoretic framework that may serve as a rationale for the impact analysis of a road like the present one, and also for road-related projects in general, is presented. Then, the concepts and methodological issues involved are discussed[3] and the procedures that have been used for the present impact analysis of widening of NH2 are explained.

An Economic-theoretic Framework

Designing an impact study for a road-related project is immensely facilitated if an economic model providing an explanation of the economic effects of a road is available. Such a model would provide an analytical framework for the study and hence help justify the choice of the specific outcome variables considered. As far as the economic analysis of the effects of the road is concerned, Walters (1968) and Jacoby (2000) developed a simple model that explains how road development (i.e. construction of a new road or expansion/improvement of an existing one) might lead to the economic betterment of the population concerned.

3. Although the present Report is an impact analysis of widening of an existing road – viz. the stretch between Dhanbad in Jharkhand and Agra in Uttar Pradesh – and not of a new road, we shall discuss here the methodological issues, etc. in a general fashion essentially because the literature on methodology for the impact study of a road-related project like the present one is rather scanty.

Briefly, as this essentially location-theoretic model demonstrates, a road development helps reduce producers' cost, increases profit, expands the size of the relevant set of production units, pushes up the opportunity cost of land, changes land use pattern in the neighbourhood of the road, etc. – all of which together result in the improvement of the level of well-being of the population living in the neighbourhood of the road. It may be noted that such a model implicitly defines an *influence zone* to which the impact of the road (improvement) is limited.

The Walters-Jacoby models offer a basic analytical support for designing a road-related impact analysis. Drawing on the lesson of this simple model, an analytical structure may be constructed, as has been done in the following paragraphs.

Suppose travel cost on NH2[4] is c (Rs./tonne km). Consider a representative person who lives at a distance d (km) away from NH2 along an approach road connecting his home to NH2. Let the (imputed) travel cost for reaching NH2 from interior be c' (Rs./tonne km). Thus, for one visit from home and back to a place on NH2 located at a distance of D km from the junction of the relevant approach road the unit travel cost is $T=2\{c'd+cD)\}$(Rs./tonne km). Suppose further that n visits to a place located at distance $(d+D)$ from home are made per unit of time (say, a day, week, month or year) by the person for socio-economic purposes (i.e. for trade, employment, education, health services, etc.). Let a trip involve a freight movement (i.e. man and material) of F (tonne). The total travel cost per unit time is then $TC= nFT = 2nFc'd+2nFcD=f(c, d, D, n, F)$, say.

Let us denote the gross benefit by $GB (Y (D, n, F), a (S))$, where Y and a stand for the gross earning per unit time (which may be reasonably assumed to be positively related to each of D, n and F) and a summary measure of the attributes of the household the person belongs to (like age-sex composition, health condition, literacy status, etc.). Let us assume a to depend on S, socio-economic infrastructural facilities like health, education, communication, justice, etc. accessed. It may be noted that gross earning Y may arise out of trade, manufacturing, supply of labour or other factor services, etc.

Given the travel cost and gross benefit (GB) as defined above, the net benefit (NB) function may be defined as $NB(c, d, D, n, F) = GB - TC$. Now, if it is assumed

4. For the convenience of exposition, let us call the concerned road/highway NH2.

that, *ceteris paribus*, *GB* is increasing concave in n, then there will be an optimal trip rate *n**, say, at which the net benefit of the person will be maximum. Next, let us see how this optimum trip rate will change if *d* is increased. Assuming *GB* to be decreasing in *d*, we readily have *n** inversely related to *d* – i.e. the optimal trip rate will be less for those living farther away from NH2. Arguing this way, there will be a threshold distance *d** from NH2 such that *n** will be zero – i.e. the population living at a distance *d** or more will not generally access NH2 on a regular basis. One may thus, in principle, define as *influence zone* of NH2 the area along NH2 falling within a perpendicular distance of a few km on either side of NH2 beyond which the effect of NH2 is negligible. What value of *d** should be chosen to define the influence zone is, however, an empirical question.

Stretching the imagination a little farther, one may argue that, *ceteris paribus*, as d decreases, *n** will increase and hence *NB* will increase and a long-run effect of such a rise in *NB* will be a positive change in household well-being attributes, if it is reasonably assumed that *S* is rising in *NB*[5]. In the context of the impact assessment of a road-related project like the present one, this discussion, thus, may be taken to serve as a rationale for three things, viz. for considering variables related to mobility and socio-economic well-being as the set of relevant outcome variables, for examining the relationship of these variables with the distance from NH2 individually, and last but not the least, for defining an influence zone for the impact study to which the effect of NH2 and its widening may be limited.

For the present impact study of upgrading of NH2, thus, the above theoretical construct suggests the following steps:

In the first step, using the pre-project baseline survey data, examine the relationship of individual well-being attributes (i.e. outcome variables) with d (i.e. distance from NH2) and estimate (or confirm the hypothesised value) of d^* and thus delineate the influence zone. Next, identify control sample households corresponding to sample households falling in the influence zone. Then compare levels of well-being attributes of influence zone households and of their matched controls and obtain estimate the benefits of living in the proximity of NH2.

5. Note that here we are implicitly assuming that the location of the socio-economic infrastructural facilities are close to the road so that persons living farther and farther away from NH2 have less access. Whether the reality will be such or otherwise will largely depend on the pattern of spatial distribution of relevant public facilities.

In the final step, repeat the exercise of the first step using the post-project resurvey data[6]. Then compare the pre- and post-upgrading estimated benefits of living in the proximity of NH2 and obtain the impact of upgrading of NH2.

As explained later, for the present impact study an appropriate influence zone of the relevant portion of NH2 has been delimited. In this context, it may be mentioned that delimitation of the influence zone automatically defines the area (lying beyond this *defined* influence zone) where the impact of the NH2 widening under consideration would be absent. As impact measurement involves comparison of the conditions (or its change between pre- and post-project situation) of the influence zone and a corresponding control zone (where the impact of NH2 or its widening is absent), such a control zone has also to be chosen appropriately. The way this choice has been done in the present case has been explained later.

Some Conceptual Issues

Some conceptual issues which are likely to complicate and bias the impact assessment of an existing or an improved road facility relate to direct and indirect effects of a road, disentangling of partial effects of a road, the issue of time factor, problem of heterogeneity of effects and delineation of the influence and control zones. These are briefly discussed below.

Direct and Indirect Effects

The impact of a road (a new one or an upgraded one) consists of direct or first-round effects, and indirect or a sum total of all later-round effects. Direct effects are mostly observed in the form of increased mobility, reduced travel time and saving of fuel and other direct transport costs. The indirect effects, on the other hand, consist of structural changes in the economy due to enhanced opportunities which would result from increase in mobility arising from the development of infrastructure. This would ultimately result in change in occupational pattern, rise in income, consumption and improvement in other dimensions of well-being. These general equilibrium effects form a whole array of forward and backward linkage effects that the presence/expansion of a road may ultimately generate[7].

6. The re-examination of the relationship of individual well-being attributes (i.e. outcome variables) with d (i.e. distance from NH2) based on the resurvey data will help ascertain whether upgrading of the highway has left the influence zone unchanged.
7. In the case of a massive project, these effects may change outputs and prices across the economy and over time.

Thus, a comprehensive impact assessment of upgrading of a trunk road like NH2 should cover a large array of issues. These include the examination of the effect on several related indicators which may be placed in three categories: (i) direct effects related to transport project outputs, such as frequency of trips, (ii) direct effects related to transport project outcomes, such as access to jobs, markets, health and education facilities, and (iii) indirect effects on income, employment, occupational pattern, financial and social infrastructure like banks and schools and on the ultimate effects on literacy, use of health service, etc.

Village-level variables relating to land use, education, health, infrastructure, transport system, etc. and household-level variables like education, health, use/ownership of means of transport, mobility etc. may be considered for the measurement of direct effects. Corresponding outcome variables which may be considered for measuring indirect effects could be a range of economic activities affecting markets, land prices, migration etc. at the village level and income, consumption, farm and non-farm employment, ownership of assets, non-farm activities, migration, etc. at the household level.

A comprehensive impact assessment may not be easy because of the extremely high information requirement involved. As indicated later, a feasible alternative to the above approach may be to identify a set of household-level outcome variables encompassing aspects of transportation and mobility, poverty and other dimensions of well-being and estimate the partial effect of NH2 on these variables for the relevant population groups. The list of these variables is given at the end of this chapter (Annexure 1).

Disentangling Partial Effects

The partial effects of a new/upgraded road on individual outcome variables may often get confounded with effects due to other interventions in respect of specific outcome variables[8]. There is always a possibility of confounding of effects of upgrading of the road with those due to other interventions. To avoid this, one would perhaps need to collect relevant information from sample households living in the influence zone by asking counter-factual questions like "*What would have been the level of a specific outcome variable had the road not been there (or had the road not*

8. For example, if through deliberate planning free primary schools are set up in villages closer to NH2, then the observed higher literacy rate among children in villages of the influence zone need not be due to better mobility resulting from access to NH2 of the population living in these villages.

been expanded)*?*". An alternative to asking such counter-factual questions is to identify, corresponding to each sample household of the influence zone[9], a set of matched sample households in another zone which is very similar in nature with the influence zone, but does not have the effect of NH2[10], and then compare the mean levels of each outcome variable for the two samples to get an estimate of the partial effects of the road or its upgrading, as the case may be[11].

The Time Factor

In the case of a new road or an upgraded one, the full impact of the road intervention may take a long time to be realised. Therefore, the pre- and post-intervention observations (which may be collected at the gap of a few years, say) with respect to the outcome variables relating to capability or entitlement factors of well-being are to be compared. A method of *double difference* as elucidated in a later part of this chapter is available for comparisons and estimating the impact of highway upgradation.

The Problem of Heterogeneity of Effects

The impact of upgrading of a road may be heterogeneous not only over space but also with respect to the different classes of population. So far as the heterogeneity of the effect across population groups is concerned, little is known about the distributional impacts of road investments (Gannon and Liu 1997). It is important to understand the heterogeneity of impacts of road investment on people of different levels of living[12]. One needs to distinguish between the short and long-term impacts as well[13].

9. In this Report, we have referred to these zones as the influence zone and the control zone, respectively.
10. Henceforth we shall call such a zone the control zone. The notion of a control zone essentially comes from the literature of non-randomised experiments (see Rosenbaum and Rubin, 1983).
11. As we shall see below, the propensity score matching technique (PSMT) is based on this line.
12. For example, if a new road leads to higher land values, there may be a tendency towards land concentration and landlessness. Those having initially greater land, education, wealth or influence will be better able to take advantage of the changes. As a result, the distributional inequality of current income and future income-earning opportunities may widen. It is quite likely that there will be a reduction in the common property resources, which may hurt the poor the most. As cheaper manufactured goods are brought in, there may be displacement of traditional craft or skill-based jobs.
13. For example, in the long term, even initial losers may win. But this is an empirical question. It is, therefore, important to collect data that allow one to distinguish impacts across groups and follow the experience of those groups long enough after the road is expanded so that the full effects can be understood. Apparently, PSMT and appropriate econometric techniques may be used profitably as complementary procedures to tackle these heterogeneity issues. Thus, while PSMT may help measure the partial effect of NH2, regression-based econometric techniques will be convenient to examine the gradient of change and thus bring out the effectiveness of the programme.

Delineating the Influence Zone

An important issue in assessing the impact of a road or its expansion is the identification of the influence zone, i.e. the area on either side of the road to which the impact is supposed to be limited. There is no discussion in the literature on the methodology for determining such a zone. The influence zone of a road may be thought to be its natural catchment area, which may cover the entire country or even other countries connected by the road in the case of an international road facility. The concept of catchment area is based on consideration of connectivity, generally indicated by origin and destination of trips. For immediate socio-economic impact, however, the zone may be delimited up to a specified distance on either side of the road.

The encompassing distance for the influence zone of a road can be defined in different ways depending on the nature of the road, how it is connected to the existing road network and the socio-demographic characteristics of the population living on its either side (e.g. population density, spatial dispersion of the population, type of economic activity). Accessibility (i.e. whether the road can be reached by travelling not more than a *reasonable* distance) is also a major criterion. Accessibility implies a distance conveniently travelled by a villager to reach the highway. This *approach distance* may be taken to be the distance that can be covered in less than 30 minutes by bicycle or in one hour on foot, i.e. a distance of 4-5 km. Thus, households in villages lying within an approach distance of 5 km on either side of NH2 may constitute the universe of influence zone households for the present study. This, however, is a pragmatic way of defining the influence zone[14].

Whether or not this definition of the influence zone is appropriate has to be empirically ascertained. In this regard, it may be mentioned that in a road related project, it is well nigh impossible to clinically identify the influence zone that will remain valid both for both the baseline and resurvey stages. What is important is that the originally delineated influence zone continues to be the dominant stretch even if the influence zone gets expanded.

14. It may be pointed out that for the present study households in villages lying within a band of 7 km of horizontal distance on either side of NH2 have been taken to form the universe, from which sample data have been collected. The horizontal distance of a village would normally differ from the approach distance, as villages may not be connected to NH2 by the shortest road. An investigation in one NH2 stretch revealed that the average approach distance of villages situated at a horizontal distance of 5 km was 7.5 km. The band of horizontal distance of 7 km considered for sampling, thus, covers a range of much longer approach distance, which may go even up to 16 km.

In the present study, the influence zone is empirically ascertained as follows. Consider a household (or village) level outcome variable, which is *a priori* positively (negatively) affected by proximity to the road of the household (or the village). In the graph showing this outcome variable as a function of the approach distance, the level of the variable should decline (increase) up to a *critical distance level* (at which the impact of the road ceases to exit) and beyond that distance the graph should be rising (falling) due to effects other than that of the road under reference. In other words, the curve showing the outcome variable as a function of approach distance *should have a change of gradient* at the critical distance level. This possibility of change of gradient has henceforth been referred to as the *Gradient of Change Hypothesis*, which, if empirically valid, should give an empirical delineation of the influence zone in terms of the estimated critical approach distance at which change of gradient takes place. In the present exercise, the relationship between individual outcome variables and approach distance has been examined mainly using the Non-Parametric Regression Technique (NPRT) explained later in this chapter and based on the results of that exercise, the empirical delineation of the influence zone has been done[15].

There is an important issues involved in the use of the notion of the influence zone in an impact study of this kind. This relates to whether the influence zone of the road expands or remains unchanged after its widening. This is a testable proposition. Applying NPRT separately on the baseline and endline survey data sets (as indicated above) one may ascertain if the influence zone of the road has expanded after its upgrading. The methodological implication of an expansion of the influence zone for the impact study is as follows. As already mentioned, measuring the impact requires delineation of a *control zone* corresponding to the given influence zone. If the influence zone changes due to upgrading of the road, the control zone will also change accordingly. Thus, if I_B, C_B denote the influence zone and control zone suggested by the baseline survey data set and I_E, C_E denote the corresponding zones suggested by the endline survey data set, one may have two alternative but equally meaningful impact measurements based on I_B, C_B and I_E, C_E, respectively[16]. The impact measures based on I_B, C_B and I_E, C_E will be essentially Laspeyres and

15. Note that as there are many outcome variables, the influence zone suggested by the results of non-parametric regression analysis for individual outcome variables need not be all same. The model value of the different estimated critical distances has actually been considered to decide the influence zone.

16. The impact measures based on I_B, C_B and I_E, C_E will be Laspeyres and Passche type measures respectively.

Passche type measures, respectively. It may be mentioned that, as reported later, in the present impact study the influence zone of the road has been empirically observed to have expanded and this has been duly taken care of in the impact measurement.

Delineating the Control Zone

Formally, the control zone should be an area having similar agro-climatic and other macro features as the influence zone[17], but with no effect of the road on the poverty and other conditions of socio-economic well-being of the households living there. In other words, the intervention (i.e. existence/widening of the road) should be the only difference between the control zone and the influence zone. Ideally the control zone should be a similar area surrounding another road very similar to the road under reference in the same region, which is not widened. Finding such a control zone is, however, extremely difficult[18].

Delineation of the control zone for the present impact study is based on a major presumption – viz. areas lying within 7 km[19] of horizontal distance on either side of the road (i.e. NH2) have very similar agro-climatic and other macro features. Given this, if areas lying within *I* km of horizontal distance on either side of the road constitute the influence zone, then areas lying beyond *I* km but within 7 km of horizontal distance on either side of the road is taken as the control zone. Thus, as discussed earlier, if the influence zone expands from I_B to I_E due to the upgrading of the road, the control zone correspondingly shrinks as per the estimate of the influence zone of the highway based on the baseline data. However, the same control zone will be identified to be the villages and houses lying beyond 6 km of approach distance but within 7 km of horizontal distance from the highway as per the estimation of influence zone based on the resurvey data.

Non-Parametric Regression Technique (NPRT)

NPRT is a convenient econometric tool that helps bring out the pattern of relationship between a pair of variables implicit in a given bi-variate data set[20]

17. As per this technique, for every sample household of the influence zone, a set of matched sample households of the control zone is selected and the impact is measured by comparing the estimated average value of an outcome variable for influence zone households and that of the matched control zone households.
18. Further, NH2 being a very old road, the villages around it must have attained a long-term social equilibrium and simply for this reason it may be impossible to find a proper control zone for measuring the impact of broadening of NH2.
19. A 7-km horizontal distance may extend up to 16 km of approach distance.
20. This technique is well-defined for examining multiple regression relationships in multivariate data sets as well. However, its use in bi-variate data set is popular.

(see Härdle, 1990)[21]. The basic idea underlying this technique may be explained as follows:

Consider a bi-variate data set $(x_i, y_i, i = 1, n)$ on a pair of random variables X and Y, where x_i, y_i denote the *i*th sample observation on the explanatory and explained variables, respectively. Given this data set, one seeks to estimate the underlying regression line $y_i = m(x_i) + \varepsilon_i, i = 1,2,...,n,$ where the algebraic form of the regression curve $m(.)$ is not *a priori* specified. In other words, the NPRT generates empirical estimates $\hat{m}(x)$ of $m(x)$ for a large set of values of the variable x in the observed range of its values. Plotting $\hat{m}(x)$ against x one gets the estimated non-parametric regression line.

The NPRT works as follows: Given the range of the sample values of the variable X, m (≥ 2) equi-spaced values of X are taken. Let a typical specified value be denoted as x. Consider the interval $(x-h, x+h)$ and let n_x be the number of observed values of X falling in this interval. Denote these values by $x_j, j = 1,2,...,n_x$. The ordinate of the non-parametric regression curve, $\hat{m}(x)$, corresponding to this value of x is then estimated by using the following Nadarya-Watson estimator:

$$\hat{m}_h(x) = \frac{n_x^{-1} \sum_{j=1}^{n_x} K_h(x - x_j) y_j}{n_x^{-1} \sum_{j=1}^{n_x} K_h(x - x_j)},$$

where the kernel function $K_h(.)$ is an appropriately chosen weighting function. There are a number of alternative forms of the kernel function that are frequently used. In the present exercise, the quartic kernel function has been used. For estimation, a value of h, the bandwidth, is to be chosen. In this context, it may be mentioned that a larger value of h yields a smoother estimated regression line (whereas a smaller value of h**,** in contrast, results in a wavy estimated line). For a given data set, the optimal bandwidth h may be decided by using the cross-validation technique[22].

21. Härdle, W., Applied non-parametric regression, Chapter 1-3, Cambridge University Press, Cambridge, 1990.
22. For a discussion on the cross-validation technique, see Härdle (1990, Ch. 5). For the present exercise the NPRT has been done using a version of STATA in which the cross-validation facility was not available. Hence, the value of h in individual cases has been chosen by visual examination of the resulting graph of the estimated non-parametric regression functions.

Needless to mention, being primarily data-driven and not based on any *a priori* functional form specification, the NPRT is a powerful tool of analysis. For the present analysis, this has been used mainly to examine the gradient of change hypothesis, i.e. the nature of the relationship between an outcome variable and the distance from NH2[23].

Propensity Score Matching Technique (PSMT)

Originally, PSMT was suggested as a device for selecting matched *control* sample units corresponding to individual *treated* sample units in a non-randomised experimental set-up for estimation of treatment effects, i.e. the impact of a controlled intervention (see Rosenbaum and Rubin, 1983). This technique has been found convenient for measuring the impact of socio-economic welfare programmes (see Baker, 2000 and Jalan and Ravallion, 2002)[24]. It involves two major steps: (i) selection of matched control unit(s) (say, households) corresponding to every sample participating unit; and (ii) estimating the effects of programmes by finding out the difference in levels of outcome variables of participating units and the corresponding matched control units.

To explain PSMT, let us consider a hypothetical targeted welfare project with the provision of voluntary participation. The population of households thus includes *participating* eligible households, *non-participating* eligible households and *non-eligible* households. Suppose a representative sample of eligible households is drawn from this population. Suppose further that for each sample household we have data $((y_i, z_i'), i = 1,2,...,n)$, where y_i is an indicator variable such that $y_i = 1$, if the sample household is a participating household and 0 otherwise, and $z_i' = (z_{1i}, z_{2i},..., z_{ki})$ is a vector of household attributes that determine individual household's participation decision, *n* being the sample size.

On the basis of this information and an important assumption that given the probability of participation, the indicator variable is not correlated with the individual

23 In the present study, Quartic (Biweight) weights have been used to define this weighting Kernel function and we have chosen the bandwidth to be 3. In order to define the grid in terms of the number of equal divisions of the range of x-variable we have taken *n* to be 3071 which happens to be the sample size pooling all the households in influence zone and control zone together in the follow-up survey. The software STATA 11 has been used to estimate these models and we have obtained the results in graphic form.

24. Jalan, J., and M. Ravallion, Income Gains from Workfare: Estimates for Argentina's TRABAJAR Program Using Matching Methods, Washington D. C.: Development Research Group, World Bank, 1998.

variables that determine participation decision[25], a logit analysis[26] will provide an estimated probability function that will give estimate of *ex ante* probability of participation (i.e. the propensity score) for each sample household. This function may be written as $p\hat{r}(y_i = 1) = h(z_i'\hat{\gamma})$, where $\hat{\gamma}$ is an estimated parameter vector and $h(.)$ is a known functional form. Using this estimated function, the propensity score is calculated for each sample household. Now, by matching the propensity score of a participating sample household with those of the non-participating ones, *a few* matched sample non-participating households are identified such that the propensity scores match (given a criterion of matching) for every participating sample household[27].

In the present study, we have taken $y_i = 1$, if the *ith* sample household is in the influence zone, 0 otherwise. The vector of household attributes consists of a set of relevant village and household level variables. Given these, the logit analysis is performed and estimated propensity scores are calculated for all influence zone and control zone households in the sample. Finally, matched control zone households corresponding to each sample influence zone household have been identified using propensity scores (or the odds ratios based on these, to be precise).

A typical logit equation for the purpose of estimating propensity scores may be written as:

$$L_v = d + gZ_v + v_v \qquad \text{where} \quad L_V = Log_e \frac{P_v}{1 - P_v}$$

where P_v is the probability of a household to belong to the influence zone, Z_v is the vector of co-variates of the households characterising its socio-economic attributes and factors relating to its proximity to NH2 and V_v is the error terms for the vth observation. The explanatory variables of this regression model are supposed to determine the composite characteristics of the influence zone in terms of the logit variable, but not supposed to include any of the outcome variables of 4-laning project or their proxies, but may include some of the village-level characteristics, including

25. This assumption is known as the assumption of *ignorability*. It guarantees the feasibility of estimating propensity score using available data on participation decision.
26. This is described later.
27. It may be noted that PSMT only requires the values of $z_i'\hat{\gamma}$ of the households being matched to be close enough, not the z vectors of the households. Although for such a matching the z vectors could have been far preferable, that would be too demanding and might make the task of finding matched household impossible.

some related to the distance characteristics of the household from the NH2. (See Annexure 2 on Logit Regression Analysis).

The above equation is estimated over the full sample of households from all the sample villages and the propensity score (predicted probability) is calculated for each sample household from the predicted values of the equation. This means that the representative sample of households within and outside the influence zone are pooled together to estimate the logit model relating the probability of a sample household belonging to the influence zone as a function of all the variables in the data that are likely to determine the composite characteristics of the influence zone. The probabilities or propensity scores yielded by the estimated regression are used for matching households of the influence zone and control zone. If the range of propensity scores for the group of households in the influence zone is similar to that for the sample of households in the control zone, then the latter can be considered as valid control group for the purpose of impact assessment.

As mentioned above, the aim of matching propensity scores is to find the closest comparison group from a sample of households outside the influence zone to the sample of households in the influence zone. For any given household in the influence zone, the matching households in the control zone are defined to be the ones which are closest to it in terms of the probability (P) for the concerned household to belong to influence zone as derived from the logit model or in terms of its odds ratio. The closest matching households may be defined to be the nearest 5 households of the control zone for any given household of the influence zone, in terms of the probability P or odds ratio P/1-P as referred to above. Or, it may be alternatively defined to be households of the control zone lying within a defined interval around the value of P or P/1-P for the given household in the influence zone. The interval has been taken to be all values of such odds ratio or probability which would satisfy:

$$\left(\frac{P_i}{1-P_i}-\frac{P_c}{1-P_c}\right)^2 < 0.005 \qquad \text{or} \qquad \left|\frac{P_i}{1-P_i}-\frac{P_c}{1-P_c}\right| < 0.0707$$

where i with it P_i is given and c with its associated P_c is variable whose values are being identified for ascertaining the closest households. While in the present study, all households of all villages of the different selected stretches of NH2 have been pooled together for finding the matching group of households for any given household in the

influence zone, this has been done to allow maximum flexibility of choice in matching the households.

There is an implicit assumption that the non-similarity of villages would not matter while comparing the outcome variable values of a household in the influence zone and those of its matching group in the control zone. While one may question the validity of such an assumption, there is a trade-off for making choice in favour of multistage matching options in terms of the sacrifice that the effective length of interval describing closeness in terms of probability or odds-ratio would be larger. Otherwise, a number of observations in the control zone may be left out of matching or a number of the influence zone households may not have adequate matching in the control zone. Besides, the limitedness of the sample size of the villages also does not permit efficient matching at the village level.

As already mentioned, since in the present impact study the influence zone is observed to have changed after upgrading, say, from I_B to I_E (and accordingly the control zone has also changed from C_B to C_E), two separate impact measurements have been done based on I_B, C_B and I_E, C_E, respectively. For the former impact measurement based on I_B, C_B, PSMT has been applied to the baseline survey data to find matched control sample households in C_B for every sample household of I_B and for the latter impact measurement based on I_E, C_E, PSMT has been applied to the endline survey data to find control sample households in C_E for every sample household of I_E.

Single and Double Differencing

Given a set of matched non-participating sample households (i.e. control) for each participating sample household, for every outcome variable, average values for the sample of participating households and the corresponding sample of matched non-participating households are calculated and compared to estimate impact in respect of each outcome variable. In calculating the average outcome indicator of the matched control units, several weighting schemes can be used, ranging from 'nearest neighbour'[28] weights to non-parametric weights based on kernel functions of the differences in scores (Heckman, *et. al.*, 1997)[29].

28. For each sample participating unit closest propensity scores in the sample non-participating units are identified in terms of the absolute difference in the propensity score. This is called 'nearest neighbour'.
29. Jalan and Ravallion (2001) discuss the choice further, and find that their results for estimating income gains from an anti-poverty programme are reasonably robust to the choice.

In the present study, the process of averaging that is used (and has been followed for different types of variables in the present exercise) is explained below:

The estimate of the average of an outcome variable for participating households should be $\bar{y}_{IZ} = \frac{\sum_{i=1}^{n_{IZ}} y_i s_i}{\sum_{i=1}^{n_{IZ}} s_i}$, where y_i: value of the per capita variable and s_i: household size of the *i*th sample participating household, n_{IZ}: number of sample participating households[30]. The average value of the variable for the matched sample non-participating households corresponding to the *i*th sample participating household is $\bar{y}_{IZi} = \frac{\sum_{j=1}^{n_i} y_j s_j}{\sum_{j=1}^{n_i} s_j}$, where n_i: number of matched non-participating sample households for the *i*th sample participating household. A comparable average[31] of variable for control sample households is then $\bar{y}_{CZ} = \frac{\sum_{i=1}^{n_{IZ}} \bar{y}_{IZi} s_i}{\sum_{i=1}^{n_{IZ}} s_i}$. Given the two averages thus obtained, the impact is measured as $\bar{y}_{IZ} - \bar{y}_{CZ}$[32], or in percentage form as $\left(\frac{\bar{y}_{IZ} - \bar{y}_{CZ}}{\bar{y}_{CZ}} \right) x100$.

30. One should use appropriate multiplier weights in this formula, if the sample design is not self-weighting.
31. Note that here the household sizes have been used as weights essentially to make the two averages comparable.
32. For a quantitative variable like the share of income from self-employment in non-agriculture, the process of averaging is explained below:

Let *y* is the total income and *s* is the total income from the self-employment in non-agriculture

(i) $\overline{y_{iz}} = \frac{\sum_{i=1}^{n_{iz}} s_i}{\sum_{i=1}^{n_{iz}} y_i}$ where y_i is the total income and s_i is income from self-employment in non-agriculture in the *ith* sample IZ household , n_{iz} being the number of household in the sample.

The impact measurement procedure based on sample average values of an outcome variable as described above is known as single difference method. One may use this for measuring the impact of an existing road (in the case of a road upgrading impact analysis based on baseline survey data). For measuring the impact of a project, one needs to compare the levels of outcome variables in pre- and post-project periods. The relevant method, known as double difference method, seeks to find the pure partial effect of a project on the levels of individual outcome variables. For example, in the case of upgrading of NH2, the impact of the project should be that part of the observed change in the level of an outcome variable which is solely due to the upgrading of NH2.

Let y_j^0 be the observed pre-project period value of an outcome variable for the *j*th sample participating household and y_j^{0m} be the mean value of the variable for corresponding matched sample non-participating households. The difference $(y_j^0 - y_j^{0m})$ measures the observed pre-project difference in the level of the outcome variable[33]. The aggregate (or average) of this difference over all sample participating households gives a measure of the initial (i.e. pre-project) difference in the level of the outcome variable under consideration between participating and non-participating households. Formally, it is written as $D_1 = \sum_j (y_j^0 - y_j^{0m})$[34].

The double difference method requires, in addition, a similar measure of difference in the post-project levels of outcome variables for each sample participating household and its matched non-participating ones. Let the required difference for the *j*th sample participating household be $(y_j^1 - y_j^{1m})$ where the

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(ii) $\overline{y_{cz}} = \dfrac{\sum_{i=1}^{n_{iz}} \sum_{j=1}^{m_{cz}} s_{ji}}{\sum_{i=1}^{n_{iz}} \sum_{j=1}^{m_{cz}} y_{ji}}$ where y_j is the total income and s_j is the income from self-employment in non-agriculture in the matched household of *i*th sample household in IZ, m_{cz} being the number of matched household in the *i*th sample household in IZ

(iii) Given the two averages thus, obtained, the impact is measured as: $\left(\dfrac{\overline{y_{iz}} - \overline{y_{cz}}}{\overline{y_{cz}}} \right) \times 100$

33. In case of the NH2 4-lanning project, one may treat this as the impact of NH2 proximity as in this case a household of the influence zone is a participating household and the corresponding matched households of the control zone are the non-participating households.
34. It may be noted that this is basically a form of impact measured by the single difference method.

superscript 1 is used to denote that the difference relates to the post-project situation, the set of sample households being the ones covered in the pre-project baseline survey. Based on these differences, an aggregate measure of difference exactly similar to D_1 is as $D_2 = \sum_j (y_j^1 - y_j^{1m})$ that measures the aggregate/average difference in the levels of the *j*th outcome variable of participating households and their matched non-participating counterparts. The pure partial effect of the project, in principle, is then given by $P = (D_2 - D_1)$. One may alternatively express this as $P = \sum_j (y_j^1 - y_j^0) - \sum_j (y_j^{1m} - y_j^{0m})$. It may be noted that the first term on the right-hand side of this expression measures the aggregate change in the level of outcome variable for the entire sample of participating households between the pre- and post-project situation and the second term measures the corresponding change for the matched non-participating households. This double difference, thus, in principle, gives the pure partial effect of the project in respect of an individual outcome variable.

Since in the present impact study the influence zone is observed to have changed after upgrading, say, from I_B to I_E (and accordingly the control zone has also changed from C_B to C_E), two separate impact measurements have been done based on I_B, C_B and I_E, C_E, respectively. Accordingly, the single and double differences of individual outcome variables have been calculated twice – once using I_B, C_B as the influence zone – control zone delineation and again using I_E, C_E as the influence zone – control zone delineation. It may be noted here that closeness of these alternative double difference estimates would indicate robustness and reliability of the measured impact.

Methodological Issues and Solutions

This method of PSMT-based double differencing of outcome requires a panel data set giving observed values of outcome variables and other associated data for the same set of sample households (both treated and control sample units) collected through the baseline survey and the resurvey. Data on such a common set of sample households for the baseline survey and the resurvey are essential, because otherwise the effect of unobservable factors, if any, cannot be eliminated (and that will lead to bias in the estimated impact)[35]. So long as the fraction of baseline sample households

35. It is often difficult to create such a panel as some of the baseline survey sample households may get missed out in the resurvey because of deliberate refusal to give information, migration or family-split (attrition bias).

that get missed out in the resurvey is not large and more importantly such missing out takes place randomly, a panel data set, formed by deleting baseline data of those sample households that got missed out in the resurvey, can be reliably used.

In the present context, the sample households of the influence zone and those of the control zone are treated as participating and non-participating households in the PSMT-based double differencing exercise. A logit regression analysis explained in the appendix is performed to estimate the probability of each sample household (irrespective of whether or not it belongs to the influence zone) and this estimated probability is used as the propensity scores for finding control zone matched households for every influence zone sample households.

In principle, for any given influence zone – control zone delineations, the matched control sample households for individual influence zone sample households can, in fact, be found in two ways – viz. using the propensity scores given either by logit regression analysis of the baseline data set or that of the resurvey data set, using the same logit regression model specification. Accordingly, two sets of double difference estimates of impact can be generated. A comparison of these estimates will help judge the robustness of the estimated impact. A final estimate of the impact may be obtained by an appropriate averaging of these alternative estimates which has been followed in the present exercise.

Pertinent questions may, however, be raised about the appropriateness of impact analysis based on PSMT-based double differencing done in the present case, in particular, and for a road-related project, in general. These range from the question of feasibility of satisfactorily delineating the control zone to the applicability of PSMT for finding matched control zone households.

Consider first the issue of control zone delineation. This has already been discussed in detail. Elaborating further, it may be mentioned that NH2 being an important part of the major road network of India and, more importantly, being on the same route as the historical route connecting the north to the east, villages located in the proximity of this highway are in some kind of a long-term social equilibrium. So these villages may not be comparable with those located in the proximity of some other highway or in the interior. This brings out the problem of latent heterogeneity due to which a matched control zone cannot be easily found and hence PSMT (which

uses just a few observable characteristics) may not be a satisfactory way for finding ideally matched control households.

PSMT-based impact evaluation is suitable for welfare projects with voluntary participation where the participation decision of an eligible household or person depends on a set of household/person specific factors. NH2 upgrading is not like such a project where the participation of household/village is non-voluntary. Hence the notion of participation (which is an essential issue in PSMT) in this case becomes somewhat artificial. It thus becomes an empirical question whether or not, there would exist a set of variables identifiable as different from the set of outcome variables, that would satisfactorily predict if a sample household would be in the influence zone or the control zone. In the present exercise of use of PSMT, we have, however, been able to identify such a set of variables.

The conclusion that emerges from the above discussion is that there is a case for the use of PSMT for impact study in the case of a road-related project like the present one. However, there seems to be important empirical issues involved – particularly in the context of choice of explanatory variables for the explanation of the very artificial notion of project participation decision in such a case. One has to choose very carefully an appropriate set of *discriminating* variables. How well this can be achieved in actual practice is an empirical question. It would, therefore, be prudent to supplement PSMT-based impact analysis by other studies based on conventional wisdom (even though the latter may not give the pure partial effect of a project that a PSMT aspires to capture).

In the present exercise, the PSMT-based impact analysis has been supplemented by participatory rural appraisal (PRA) which, *inter alia*, includes reflexive or generic controls, whereby direct questions to the respondents are asked as to how much they think their situation has improved due to the road, or whereby the observed evolution is compared to what happened region-wide or even country-wide. In reflexive comparisons, the participants themselves provide the control information by comparing themselves ‘before’ and ‘after’ receiving the intervention. With generic comparisons, the impact of the intervention on beneficiaries is compared with established norms about typical changes occurring among the target population. Shadow comparisons consist of the judgement of experts, project administrators

and/or selected participants on what is ordinarily to be expected in the case of the target population as compared to actual outcomes.

Data Requirement

The impact study of the widening of NH2 would require pre- and post-project household- and village-level data in respect of possible outcome variables. The impact assessment has, therefore, been set up in two stages. Further, it relies primarily on survey-based collection of data and quantitative analysis of such data. The relevant universe comprises all households living in villages belonging to the defined influence and control zones of the selected stretches of NH2.

For the purpose of the study, the area of covering this universe has been portioned into seven representative stretches in terms of agro-climatic and other macro features. The sample design adopted for each of these stretches is a stratified two-stage sample – villages being the first stage and households the second stage. The first stage sample units have been selected using the probability proportional to size (PPS) without the replacement technique, and those in the second stage have been selected by using the circular systematic sampling technique. The sample design and the sampling procedure followed have been explained in detail in Chapter 2.

Annexure 1: List of variables used for socio-economic impact assessment of national highway

Village variables
Demographic
V1 Population density (population per sq km)
Incidence of poverty
V2 Proportion of BPL households
Transport infrastructure
V3 Share of motorised vehicles in total transport vehicles
Employment
V4 Proportion of non-agricultural workers in total main workers
Asset ownership
V5 Number of milch animals per household
V6 Proportion of semi-pucca and pucca houses
Education and other infrastructure
V7 Number of teachers per school
V8 Number of enrolled students per school in the year 2002-03
V9 Number of girl students enrolled per school in the year 2002-03
V10 Proportion of literate population above 6 years of age
V11 Whether a village has banking facility
V12 Whether a village has cooperative society
Price of land and dairy products
V13 Price of irrigated crop land (Rs./acre)
V14 Price of unirrigated crop land (Rs./acre)
V15 Price of residential land (Rs./acre)
V16 Sale price of milk (Rs./litre)
Household variables
Incidence of poverty
H1* Whether household is poor based on poverty line measured in terms of monthly per capita income (MPCY)
H2* Whether household is poor based on poverty line measured in terms of monthly per capita consumption expenditure (MPCE)
Mobility (weekly)
H3 Per capita trip rate (PCTR)
H4 Per capita trip rate for work
H5 Per capita trip rate for marketing
H6 Per capita trip rate for education
H7 Per capita trip rate for accessing health-related services
H8 Per capita trip rate involving travel on NH2
H9 Per capita trip length for trips involving NH2
H10 Per capita travel expense for trips involving NH2
H11 Per capita travel time for trips involving NH2
H12 Travel cost per person km for trips involving NH2
Income, employment and occupation
H13 Per capita income (annual) (Rupees)
H14 Per capita consumption expenditure (monthly) (Rupees)
H15 Share of income from self-employment in non-agricultural activities
H16 Share of food in consumption expenditure
H17 Proportion of working members in a household in age group 15-59 years
H18 Proportion of working female members in a household in age group 15-59 years
H19 Proportion of non-agricultural workers in total working household members.
Asset ownership
H20* Whether a household is landless
H21* Whether a household owns at least one information related consumer durable (like TV, radio, etc.)
H22* Whether a household owns at least one motorised transport vehicle
Education and health
H23 Proportion of school-going children among all children in the household in age group 6-14 years
H24 Proportion of female school-going children among all female children in the household in age group 6-14 years
H25 Proportion of household members who availed of medical facilities during last six months
Attitudinal response
H26* Whether a household rates itself as poor
H27* Whether a household expects improvement in employment situation after 4-laning of NH2
Well-being index
H28 Index of overall well-being based on income, employment, health and education (BORDA index)
H29 Index of transport mobility (BORDA index)
H30 Index of access to infrastructural facilities, assets and amenities (BORDA index)

** These are qualitative binary variables.*

Annexure 2

Logit Regression Analysis

An important ingredient of PSMT is the logit analysis used to estimate propensity scores. It is a convenient econometric tool for the analysis of a bi-variate (or multivariate) data set comprising a binary qualitative dependent variable (see Maddala (1986))[36]. This technique is briefly explained below:

Consider a population in which some units possess a particular feature (e.g., in a population of households some are poor). If a unit is picked up from the population at random, the probability that the selected unit will have the feature depends on a deterministic factor (that is a function of a set of explanatory variables) *plus* a random error. Now, suppose a random sample of n households is drawn from the population. Let y_i = 1, if the ith sample household is observed to have the feature and 0 otherwise, and $x_i' = (x_{1i}, x_{2i}, ..., x_{ki})$ is the observed values of the relevant explanatory variables for the ith sample unit (i = 1, 2,…, n, there being n sample households).

To explain the observed variation of the sample y_i values, the following latent variable regression model is specified: $y_i^* = x_i'\beta + \varepsilon_i, i = 1,2,...,n,$ where y^* is an unobservable variable, $\beta = \{\beta_1, \beta_2, ..., \beta_k\}$ is the vector of coefficients associated with k explanatory variables and $\varepsilon_i's$ are random disturbances. Given this relationship, for a sample unit with a given set of values of explanatory variables $y_i = 1$ if $y_i^* > 0$ and it is 0 otherwise[37]. Now, it is assumed that the random disturbances ε_i's are identically distributed following a logistic distribution. That means, Prob ($y_i = 1$)= $p_i = \dfrac{1}{1+\exp(x_i'\beta)}$, or equivalently $\dfrac{p_i}{1-p_i} = x_i'\beta$[38].

Given the sample observations $(y_i, x_i', i = 1,2,...,n)$, the logit model is estimated by maximum likelihood method. Once the estimation has been done, the

36. Maddala, G. S., Limited-dependent and qualitative variables in econometrics, Chapter 2, Cambridge University Press, Cambridge, 1986.
37. In other words, $y_i = 1$ if $\varepsilon_i > -x_i'\beta$.
38. Note that the latter expression shows that odds ratio is a linear function of the explanatory variables under the logit model.

odds ratio can be calculated for the individual sample[39] to derive the probability measure of a household to fall in the influence zone.

39. However, before using the estimated probabilities and/or the corresponding odds ratios one should ensure that the model has fitted satisfactorily to the given data set in the sense that the classification of the sample units based on the estimated *ex ante* probabilities matches fairly well with the corresponding *observed* classification. Along with the estimated parameter values, their standard errors and the maximised log-likelihood value, values of other relevant sample statistics are provided by standard econometric software. While these may be adequate for performing standard tests of hypotheses that are often required, there does not exist any straightforward technique for visualising the performance in terms of the goodness of fit of the estimated logit model (i.e. whether the classification of sample units based on estimated probabilities would closely match the observed classification). It may, however, be possible to devise some *ad hoc* empirical devices for such goodness of fit examination.

Chapter 2

Survey Structure and Methodology

Sampling design

Sampling is a long-established practice. The principal object of any sampling procedure is to secure a sample which will reproduce the characteristics of the population (a collection of units being studied) as closely as possible. The method results in economy of effort and at the same time provides accurate outcomes.

All rigorous sampling demands a subdivision of the material to be sampled into units, termed sampling units, which form the basis of the actual sampling procedure. In general, when a given proportion of the material is included in the sample, the smaller the sampling units employed, the more accurate and representative will be the results. This remains true even if multi-stage sampling is adopted.

The selected units must be clearly and unambiguously defined. This demands the existence or construction of a sampling frame, i.e. a list that identifies every unit within the target population. Such a list helps identifying each individual member of the population unambiguously.

A random sample is the simplest form of a rigorously selected sample and provides the basis for most of the more complicated sampling methods. In a random sample, after subdividing the material into sampling units, the requisite number of units are selected at random from the whole population of units.

In the case of a stratified sample, the population of sampling units is subdivided into groups or strata before the selection of the sample. A stratified sample is, thus, equivalent to a set of random samples on a number of sub-populations, each equivalent to one stratum. A population may be stratified for two or more different characteristics. If a selection is made from sub-strata comprising the various combinations of the main classifications, the procedure is exactly similar to ordinary stratification, the sub-strata being equivalent to the strata.

In multi-stage sampling, the material is made up of a number of first-stage sampling units, each of which, in turn, is made up of a number of second-stage units, etc. The sampling procedure is carried out in stages. In the first stage, the first-stage units are selected by a suitable method such as random or stratified sampling. In the second stage, a sample of second-stage units is selected from among the selected first-stage units by a method which may be the same or different from the method employed for selecting the first-stage units. Further stages may be added as required. Multi-stage sampling, thus, introduces an element of flexibility into sampling design and enables utilising of the existing natural divisions and subdivisions of the material.

In the choice of the sampling frame, the following considerations were also taken note of:

(i) Almost all surveys in general and surveys of households in particular are multipurpose enquiries. They are designed to estimate numerous characteristics on a variety of topics and sub-topics.

(ii) Just as a survey is seldom designed to measure a single variable, similarly, it is seldom designed to measure variables at a single level of aggregation.

Scope of the enquiry

The scope of the enquiry was confined to the rural population.

General design

The sample design was based on an appropriate stratification of village and household units in order to make sampling units homogeneous within each stratum. The general scheme of the sampling plan was a stratified two-stage design with census villages as the first stage units (FSUs) and households within the sample villages as the second stage units (SSUs). It may be mentioned that a stratified design takes care of the variability factors and the two-stage design addresses the problem of non-availability of a usable frame of the ultimate sampling units.

Delimiting influence zone

As mentioned in Chapter 1, a contiguous band of 5 km on both sides of NH2 has been taken to be the influence zone[1].

1. The influence zone limits impact assessment analysis as the adaptation of the impact assessment method and the definition of a zone of influence are interdependent, because both are a function of the characteristics of the road and the surrounding area.

Identification of representative stretches

The national highway between Agra and Dhanbad extends over a distance of 995 km. Subjecting this entire length to a detailed survey would have involved huge resources. It was, therefore, postulated that the purpose would be adequately served if the scope of the enquiry were confined to representative stretches covering around 25 percent of the distance, i.e. 200-250 km of the road length. Thus, the foremost task was to identify homogeneous and representative stretches spanning the three states of Uttar Pradesh, Bihar and Jharkhand. The following criteria were adopted for the purposes of selecting the stretches:

(i) should essentially cover rural areas;
(ii) should have homogeneous agro-climatic characteristics;
(iii) should be representative of the incidence of poverty in the district concerned;
(iv) should form part of a single planning unit.

Rural coverage

The national highway passes through both rural and urban areas. Since the focus of the present study is the rural population, the stretches have, essentially, to lie in the rural areas. Therefore, while selecting each stretch, care was taken to identify a contiguous segment of rural areas not having any urban habitation.

Agro-climatic regions

The agro-climatic characteristics of a region refer to soil quality, climate, rainfall, and water resources. Based on these characteristics, the Planning Commission has divided the country into the following 15 agro-climatic regions, which have been further divided into sub-regions. The purpose of this division is to promote farming systems of optimum crop production suited to the related agro-climatic features.

(i) Western Himalayan	(ii) Eastern Himalayan	(iii) Lower Gangetic Plains
(iv) Middle Gangetic Plains	(v) Upper Gangetic Plains	(vi) Trans- Gangetic Plains
(vii) Eastern Plateau and Hills	(viii) Central Plateau and Hills	(ix) Western Plateau and Hills
(x) Southern Plateau and Hills	(xi) East Coast Plains and Hills	(xii) West Coast Plains and Ghats
(xiii) Gujarat Plains and Hills	(xiv) Western Dry	(xv) Islands

NH2 falls in three agro-climatic regions and five sub-regions. Care was taken that the chosen stretches were representative of these regions and sub-regions, as shown in Table 1.

Table 1: State and district-wise agro-climatic sub-region distribution

State	District	Agro-climatic region	Sub-region	Chosen stretches for survey purpose
Uttar Pradesh	Agra	Upper Gangetic Plain	South Western Plains	
Uttar Pradesh	Firozabad	Upper Gangetic Plain	South Western Plains	√
Uttar Pradesh	Etawah	Upper Gangetic Plain	South Western Plains	
Uttar Pradesh	Auraiya	Upper Gangetic Plain	South Western Plains	√
Uttar Pradesh	Kanpur Dehat	Upper Gangetic Plain	South Western Plains	
Uttar Pradesh	Kanpur Nagar	Upper Gangetic Plain	South Western Plains	
Uttar Pradesh	Fatehpur	Upper Gangetic Plain	Central Plains	√
Uttar Pradesh	Kaushambi	Upper Gangetic Plain	Central Plains	
Uttar Pradesh	Allahabad	Upper Gangetic Plain	Central Plains	
Uttar Pradesh	Sant Ravidas Nagar	Middle Gangetic Plain	Eastern Plains	
Uttar Pradesh	Varanasi	Middle Gangetic Plain	Eastern Plains	
Uttar Pradesh	Chandauli	Middle Gangetic Plain	Eastern Plains	√
Bihar	Bhabua	Middle Gangetic Plain	South Bihar Plains	√
Bihar	Rohtas	Middle Gangetic Plain	South Bihar Plains	
Bihar	Aurangabad	Middle Gangetic Plain	South Bihar Plains	
Bihar	Gaya	Middle Gangetic Plain	South Bihar Plains	√
Jharkhand	Chatra	Eastern Plateau & Hill Regions	Chotta Nagpur Hills	
Jharkhand	Hazaribagh	Eastern Plateau & Hill Regions	Chotta Nagpur Hills	√
Jharkhand	Giridih	Eastern Plateau & Hill Regions	Chotta Nagpur Hills	
Jharkhand	Koderma	Eastern Plateau & Hill Regions	Chotta Nagpur Hills	
Jharkhand	Bokaro	Eastern Plateau & Hill Regions	Chotta Nagpur Hills	
Jharkhand	Dhanbad	Eastern Plateau & Hill Regions	Chotta Nagpur Hills	

Source: NSSO, Government of India, 1993-94 and Alagh, Y. K, 'Land and Man: Essays in Sustainable Development', 1996.

Incidence of poverty

Estimating poverty and identifying the poor, though closely related, are not one and the same. The first is a task assigned to the Planning Commission and is done through sample surveys on consumer expenditure conducted by the National Sample Survey Organisation (NSSO). The identification of the poor is done through door-to-door surveys with total coverage. The state governments under the overall direction of the Union Ministry of Rural Development carry out these surveys. The census results give an estimate of the percentage and number of poor households at the village, block, district and state levels, while the NSSO surveys estimate poverty at the state level.

While estimating poverty helps in assessing its magnitude, the identification of specific households living 'below the poverty line' is necessary for targeting them under various poverty alleviation programmes. We have, therefore, used the latter data while selecting the stretches. Care was taken that, as far as possible, only areas with reported higher incidence of poverty were covered. For instance, in Uttar Pradesh, the highest incidence of poverty was reported in Auraiya district where 47.96 percent of the households were enumerated as BPL. A stretch falling in this district was, therefore, included. Similarly, in Bihar, a stretch falling in Gaya district, with a

reported BPL household percentage of 69.83 and in Jharkhand, a stretch falling in the district of Hazaribagh with a reported BPL household percentage of 66.18, was included.

Planning unit

A single planning unit was taken as one of the criteria for choosing the stretches because it would help to understand a self-sustaining region while evaluating a specific programme. Such a unit can be defined as an area having economic and administrative homogeneity. It is large enough to enable substantial changes in distribution and employment to take place within its boundaries, yet is small enough for its planning problems to be seen as a whole. In India, for the purpose of national planning, a district is taken as a planning unit. Care was, therefore, taken that a stretch fell in a single district and there was no overlap either across the districts or the states.

Formation of basic strata

Seven road stretches covering a total of 264 km of road length have been demarcated out of 995 km of the highway falling in the states of Uttar Pradesh, Bihar and Jharkhand. Each stretch is homogeneous with respect to agro-climatic characteristics and the incidence of poverty and is synchronised with planning and administrative geographic area. The details of the stretches are outlined in Table 2 below.

Table 2: Details of stretches

Stretch	District	State	Length (km)	District level % of poverty
Asfafabad-Mithepur	Firozabad	Uttar Pradesh	47	15.48
Lalpur-Purwa Rahat	Auraiya	Uttar Pradesh	27	47.96
Galtha-Sangaon	Fatehpur	Uttar Pradesh	37	31.73
Dahia-Naubatpur	Chandauli	Uttar Pradesh	36	34.70
Mahwaria-Khosmabad	Bhabhua	Bihar	47	43.04
Bairbigha-Barachatti	Gaya	Bihar	39	69.83
Barhi-Laimbua	Hazaribagh	Jharkhand	31	66.18

General characteristics of the basic strata

The four stretches in the state of Uttar Pradesh fall in the districts of Firozabad, Auraiya, Fatehpur, and Chandauli. The two stretches in Bihar lie in the districts of Bhabhua and Gaya. The stretch in Jharkhand falls in the district of Hazaribagh. In these selected stretches, 1,697 villages lying in the horizontal distance band of 0-7 km on both sides of NH2 were identified. This distance band covers both

the influence and the control zones. Table 3 shows the stretch-wise distribution of villages, population and residential households based on the 1991 census.

Table 3: Formation of basic strata

Stretch	District	No. of villages	Population	Residential households
I	Firozabad	243	306603	46420
II	Auraiya	162	184546	27735
III	Fatehpur	170	224491	37874
IV	Chandauli	332	384630	52921
V	Bhabhua	254	230709	29237
VI	Gaya	417	323096	45084
VII	Hazaribagh	119	114028	14130
Total		1697	1768103	253401

The strata falling in the states of Uttar Pradesh and Bihar are endowed with the water resources of the rivers Yamuna and Ganga, good annual rainfall in the range of 550-900 mm, and fertile alluvial soil of the Indo-Gangetic Plain. According to the village directory of the Census of India 1991, the people living in these stretches have a fairly enough drinking water, access to educational facilities, and power supply. They are, however, poor in health facilities, and transport and communication connectivity.

Basic Strata I to IV, which fall in Uttar Pradesh, are homogeneous with respect to physiographic characteristics, irrigation, power supply, education, health and connectivity. Annual rainfall in this region is in the range of 550-700 mm and relative humidity during the driest part of the year is below 20 percent. Principal crops are wheat, rice, sugarcane, pulses and potatoes. The availability of canal and tube-well water and power supply is reasonably good.

Basic Strata V to VII falling in Bihar and Jharkhand have high rainfall (more than 700 mm in a year) and high relative humidity. The cropping pattern, therefore, changes in favour of paddy. The area is characterised by low irrigation and power supply, lower educational facilities, and still lower health facilities. In the case of Stretch VII in Jharkhand, which lies in the sub-region of Chotta Nagpur hills, the soil type changes so also the physiographic characteristics.

Further insights into the socio-economic profile of the basic strata and the infrastructural facilities available therein may be had from the details presented in Annex 1.

Sample size and allocation of sample to basic strata

Taking into account the principle enunciated above and the details outlined in the note on the determination of sample size given in Annex 2, a sample of 200 villages spread over all the 7 basic strata was considered appropriate for the enquiry. To ensure proper spread, the principle of proportional allocation was adopted and sample villages were allocated to each basic stratum in proportion to the strata size, as indicated in Table 4.

Table 4: Allocation of sample villages to basic strata

Basic strata	District	Strata size (no. of villages)	Total population 1991	Share of population	Sample size allocated (no. of villages)
Stretch I	Firozabad	243	306603	17.34	35
Stretch II	Auraiya	162	184546	10.44	21
Stretch III	Fatehpur	170	224491	12.70	25
Stretch IV	Chandauli	332	384630	21.75	43
Stretch V	Bhabhua	254	230709	13.05	26
Stretch VI	Gaya	417	323096	18.27	37
Stretch VII	Hazaribagh	119	114028	6.45	13
Total		1697	1768103	100.00	200

The sampling proportion adopted in the survey compared favourably with that adopted by the National Sample Survey Organisation while conducting their quinquennial surveys. Table 5 shows the comparative position.

Table 5: Coverage of sample villages and sample households

	Total no. of villages	No. of sample villages	% of total villages	Total no. of households	No. of sample house-holds	% of total house-holds	Population	Population covered	% of total population
NSSO	638,365	6,208	0.97	191,963,935	165,244	0.09	1,027,015,247	819,013	0.08
Our survey	1,697	200	11.78	253,401	3,200	1.26	1,768,103	20,389	1.15

Source: (1) Census of India 2001; (2) Employment and Unemployment Situation in India, NSSO, 2001.

Further refinements in stratification

To take into account the variability factor further, the selected stretches were divided into four groups depending upon the nature of influence of the 4-laning of NH2 on the socio-economic conditions of the rural households. It was felt that most of the benefits would accrue to the households lying in the horizontal distance range of 0-1 km from NH2 and the least affected households would be those which are within the horizontal distance range of 5-7 km from NH2. The other two groups of households are those within the horizontal distance of 1-3 km and 3-5 km. As explained in Chapter 1, the influence of NH2 will progressively decline over these distance ranges as one moves away from the highway. Each of these distance ranges

was considered to constitute a separate stratum within the basic strata. In essence, the sample villages in each of the basic strata were grouped into the above four distance range strata forming altogether 28 effective strata. The sample sizes allocated to the basic strata were further reallocated to the distance strata, again in proportion to the size of the distance strata based on population. The details of the allocation of sample villages to distance strata are given in Table 6.

Table 6: Allocation of sample villages to distance strata within the basic strata

Basic strata	District		Distance strata				Total
			0-1 km	1-3 km	3-5 km	5-7 km	
Stretch I	Firozabad	Population	80620	89867	64247	71869	306603
		Population (%)	26.29	29.31	20.95	23.44	100.00
		No. of villages allocated	9	10	8	8	35
Stretch II	Auraiya	Population	41903	49298	50566	42779	184546
		Population (%)	22.71	26.71	27.40	23.18	100.00
		No. of villages allocated	5	5	6	5	21
Stretch III	Fatehpur	Population	53306	56495	65065	49625	224491
		Population (%)	23.75	25.17	28.98	22.11	100.00
		No. of villages allocated	6	6	7	6	25
Stretch IV	Chandauli	Population	70557	107557	98190	108326	384630
		Population (%)	18.34	27.96	25.53	28.16	100.00
		No. of villages allocated	8	12	11	12	43
Stretch V	Bhabhua	Population	57526	81173	39147	52863	230709
		Population (%)	24.93	35.18	16.97	22.91	100.00
		No. of villages allocated	7	9	4	6	26
Stretch VI	Gaya	Population	95324	86256	79459	62057	323096
		Population (%)	29.50	26.70	24.59	19.21	100.00
		No. of villages allocated	11	10	9	7	37
Stretch VII	Hazaribagh	Population	51560	24848	22624	14996	114028
		Population (%)	45.22	21.79	19.84	13.15	100.00
		No. of villages allocated	6	3	2	2	13

Selection of sample villages (first stage units)

For each of the basic strata and the distance strata within the basic strata, separate sampling frames of census villages were constructed. The selection of sample villages was done by the method of simple random sampling without replacement. The sample villages chosen are listed in Annex 3.

Selection of sample households (second stage units)

Households within the selected villages constituted the second stage sampling units. A fresh updated list of households was prepared for each of the sample villages to facilitate selection of sample households. This opportunity of listing was utilised to prepare an updated sampling frame that helped a deeper stratification of households at the village level leading to the selection of a far more representative sample. The following aspects merit specific mention in this context.

Listing: To control the workload at the listing stage, it was postulated that a maximum of 200 households in a village would be enough to select 16 sample households (ultimate stage units). This number was considered to be fairly adequate for the purpose of using it as sampling frame. If the number of households in a village exceeded 200, the following procedure was adopted for selecting the 200 households for listing. A rough estimate of the number of households in each hamlet (tola) of a village was obtained from the head (Pradhan/Sarpanch) of the village. The number of households to be listed in a hamlet was then obtained by multiplying the share of hamlet households to the total number of village households with 200. For example, if a village had 1,000 households residing in five hamlets and in one hamlet, the number of households was 400, the proportion of households in this hamlet to the total number of households would be 400/1000 = 0.40. Thus, the number of households to be listed in that hamlet would work out to $0.40 \times 200 = 80$. Every fifth household would thus be listed in that particular hamlet.

Sub-stratification: At the time of listing, all the households in a village were classified in the categories of 'affluent households' and 'the rest'. A household was treated as affluent if it owned items like car/jeep, colour TV, telephone, consumer durables like VCR, or refrigerator; or owned a large well-maintained pucca house, or owned land in excess of 20 acres of cultivable land or 10 acres of irrigated land; or where at least one member of the household had a well-paid salaried job or was engaged in a profession with handsome income, like doctor, advocate, etc.; or was the owner of a large business establishment.

Information relating to the major sources of income of each household was also collected. The households were categorised as 'self-employed in non-agriculture' or 'rural labour' or 'others' on the basis of this information.

All the households listed in a sample village were segregated into two second stage strata, viz. 'affluent households' (forming second stage stratum 1) and 'the rest' (forming second stage stratum 2). The latter stratum was further stratified into three categories: self-employed in non-agriculture, rural labour, and others. The size of sample households in stratum 2 was in proportion to the number of households in each of these categories.

Procedure for the selection of households

A total of 16 households were selected from each sample village as follows:

(i) Two sample households from 'affluent households' (sub-strata 1) circular systematically with a random start.

(ii) Fourteen sample households from sub-strata 2. These were selected from the rest of the households circular systematically with a random start.

Survey schedules

In order to generate data on village and household characteristics as well as different socio-economic causal factors and outcomes of the developmental intervention of four-laning of NH2, extensive schedules were prepared for the primary baseline survey with emphasis on the following, and the pre-testing of the schedules was done before their finalisation.

(i) Enable collection of accurate information to meet the needs in a timely manner;

(ii) Facilitate the work of data collection, processing and tabulation;

(iii) Ensure economy in data collection; and

(iv) Permit comprehensive and meaningful analysis and purposeful utilisation of data collected.

Since the present study is the first of its kind in the country, we utilised the inputs of the researchers in the World Bank in preparing detailed schedules. We also had the benefit of the advice of the National Sample Survey Organisation (NSSO), which has wide experience in undertaking socio-economic household surveys in the country. In addition, we referred to the questionnaires used by the Census of India to elicit information on economic variables and also benefited from the related surveys carried out by different research institutions.

Both the village and household schedules are fairly comprehensive and some of the information collected may not be utilised for the socio-economic impact analysis. It was, however, felt that the same would be useful as a qualitative input for the participatory rural appraisal for which a separate exercise was carried out. The data would also be useful for further research in different aspects of socio-economic conditions at the regional level. Care was, however, taken that the length of the schedules in no way fatigued the respondent and the investigator during the course of the interview.

The schedules provide detailed information relating to the coordinates of the sample villages and sample households. This would help in identifying the same set of villages and households which would be surveyed in the follow-up exercise after a lapse of 4-5 years. The schedules also show the dates when the survey was carried out so that the follow-up survey is carried out in the same period to the extent possible so as to eliminate seasonality factor bias.

A broad format of the socio-economic variables detailed in the village and household survey schedules is given in Box 1. These variables can be clubbed into three broad categories relating to transport; income and expenditure; and social aspects.

Box 1: List of variables

(i) Transport variables

Connectivity to national highway
Type of road connectivity from village to NH
Distance of the village from NH

Accessibility
Nearest distance of the village to different facilities (e.g., market, urban centre, educational institution, medical facility, etc.)

Traffic density
Availability of public transport
Frequency of public transport (bus, jeep, taxi, tempo, etc)

Fares and costs
Passenger fares
Transport cost of agricultural inputs (seeds, fertilisers, pesticides)
Transport cost of agricultural products
Transport cost of non-agricultural products

Transport patterns
Number of trips taken outside village, by purpose
Time required to reach selected destinations (nearest city, market, school, health centre, workplace.)
Main mode of transport to selected destinations

Vehicle ownership
Ownership of vehicles (motorised and non-motorised)

(ii) Income and expenditure variables

Impact on agricultural activities
Land use pattern
Ownership of land
Land devoted to different crops
Output of key crops per unit of cultivated land
Amount of harvest sold in markets
Use of improved seeds, fertilizers, herbicides, pesticides
Use of farm equipment (tractors, machines)
Farm-gate prices of key crops
Unit price of farm inputs
Number of people (household members, other) working on farm
Agricultural wage rate
Livestock ownership
Evacuation of agricultural surplus

Impact on non-agricultural activities
Number of stores/shops in village
Ownership of non-agricultural household enterprise (by type)
Number of days worked outside farm
Employment pattern (on-farm, off-farm)
Non-agricultural wage rate
Income and expenditure pattern
Level and source of income
Consumption expenditure and its composition
Markets
Distance to market
Number and type of shops in the village
Prices
Price of key traded commodities
Price of land
Price of housing
Others
Land tenure
Access to credit
Number of migrants
Number of persons/days of employment generated by road construction/ maintenance
Ownership of consumer durables
Percent of land irrigated
Institutions within the village (bank, post office, police station, etc.)
Housing condition
Energy use (use of biomass, LPG, kerosene, etc.)
Sanitation (toilet facilities)
Drinking water resources/tap water
Electrification
Number of BPL families in the village
(iii) Social variables
Education
Number of primary schools in the village
Primary school enrollment rate (by gender)
Secondary school enrollment rate (by gender)
Primary school drop-out rate (by gender)
Distance to nearest primary/secondary school
Quality of schools
– Qualifications of teachers
– Reason for absenteeism of teachers
Health
Distance to nearest health centre/hospital
Number of visits to health facilities (by age/gender)
Number of family members who could not visit health centre due to bad road conditions
Number of visits by medical practitioner to the village
Political participation
Number of visits to government officials
Membership of community or political organisations
Number of government programmes accessed
Involvement of community in road maintenance

The core of the study included, to start with, an enquiry to gather basic particulars at the village level to enable building a framework for a proper appraisal of the ground realities followed up with a comprehensive household survey focused on the rather complex content area. The following gives a brief review of the content of major topics and sub-topics of both household and village schedules and the rationale for covering these topics.

Household schedule

Household characteristics

The schedule provides a general overview of household characteristics such as household size, social and religious status, and inward migration. This data are relevant for the purpose of analysis and are included as basic particulars.

Roster of household members

The household roster records the composition of the household and collects basic socio-economic information about its members (age, gender, marital status, educational attainments, occupation, etc.). Information on place of work, travel time and modes of transport is also included under this section.

Household economic activities

In rural areas, members of many households are engaged in self-employment. Most of such activities are seasonal. Taking this feature into account, efforts have been made to design the survey instrument in such a way as to reflect these characteristics adequately. For this purpose, the standardised concept of activity status has been adopted as per the National Industrial Classification Code 1998 of the Central Statistical Organisation, Government of India.

Housing and amenities

Data on housing and other amenities are necessary as supplementary information. The schedule obtains information on the type of housing and available amenities (drinking water, electricity, energy use, sanitation).

Assets holding

Assets holding constitutes a major factor while assessing the standard of living of the people residing in the rural areas. Hence, information relating to assets holding (consumer durables, production equipment, vehicle ownership, etc.) has been collected in sufficient detail indicating, *inter alia*, the purchases during the last 12 months and the expenditure incurred on the same.

Landholding and agricultural production

The schedule includes information on landholding and agricultural production. This covers the total operational landholding of the household, and area under different crops and the total produce, including agricultural byproducts. To understand the role of transport in the evacuation of agricultural surplus, information was sought on modes of transport used and the cost involved for the same.

Livestock

Livestock is an important source of livelihood in the rural areas. The schedule seeks information on the livestock ownership, yield of animal products, and expenditure incurred on livestock maintenance. Special attention has been given to the role of transportation in the evacuation of animal products by collecting information on modes of transport used and the cost involved for the same.

Non-farm sector

An important aspect of road development is to measure its impact on the non-farm sector. The schedule addresses this aspect by incorporating information on non-agricultural enterprises, employment and productivity in such enterprises. The schedule also seeks detailed information on informal units. To enable accounting without omission or duplication, efforts were made to gather separate details for entrepreneurial activities in handicraft or cottage industries and other income-generating activities in trade, transport, communication, personal services, etc. To have a better idea about the role of transportation in the growth of the non-farm sector, the process of evacuation of non-agricultural products and transportation costs involved are also incorporated in the schedule.

Household income

Conceptually, household income is the sum of money income and income in kind and consists of receipts which, as a rule, are of a recurring nature and accrue to household members regularly at frequent intervals. It includes individual income of all household members and the combined income of the household, either in cash or kind. The schedule comprises information on income from agriculture (including livestock), self-employment in non-agriculture, salary or wage-paid employment, and income from other sources. Taking into account the difficulties and complexities involved in the measurement of income, especially in the context of the likely preponderance of self-employment activities, special efforts have been made to

provide for all possible cases through a detailed structured approach. The household income relates to a period of one year preceding the date of survey.

Consumption expenditure

Monthly consumption expenditure is an important aspect when measuring the standard of living of the rural population. The schedule, therefore, seeks detailed information on both food and non-food items. In the case of food items, the recall period has been limited to 30 days, while in the case of non-food items, the recall period varies between 30 days and 365 days.

Education

Information on education has been collected in a detailed manner so as to assess the impact of the project on the educational attainment of the household members. In addition to the current educational status, the survey was also designed to understand the problems and prospects of children in the age-group 6-15 years in pursuing education in institutions located within and outside the village. Of special interest was the detailed recording of distance from educational institutions, time and modes of transport.

Health

Health is a principal component of social consumption. It is important to collect information about the extent to which medical and health services and facilities available in and around the village are availed of by the household members. Marginally extending the scope of health-related information, the issue of the mobility of members in availing of health facilities in terms of distance travelled, mode of transport and time taken in travel were also enquired into.

Participation in community affairs

Road construction and improvement may not only facilitate access to education and health facilities but may also enhance social interaction and political participation. The purpose of the schedule is also to capture the household's involvement in these aspects of community life. Social attitudes, gender discrimination, attendance at social and political events in and outside the village are some of the issues that are included in the schedule.

Diary of travel activity

To see the direct effects of road development in terms of the mobility of household members, special provision has been made in the schedule to obtain travel-related information through the approach of origin-destination trips. Trip has been defined as one-way movement of a person by any mode of transport having two trip ends – an origin or start of a trip and a destination or end of a trip – for a specific purpose. For the current study, only information on trips outside the village was collected; information on trips within the village was not recorded. The travel diary also seeks information on trip purpose, trip length, mode of transport used, and use of national highway in the course of a trip, travel cost and time. In order to control errors and bias creeping into the data, the reference period for capturing the details was kept at the optimal level of seven days prior to the date of enquiry.

Information on household members' preferred mode of travel, their attitudinal response to development activities in the village, their perception and opinion on the highway development project, etc. would be very significant to supplement the database. Adequate provision to gather data on these aspects has been made in the household schedule.

Village schedule

General characteristics

The schedule provides a general overview of the demographic characteristics of the villages (population size, social/religious composition), and their major social and economic infrastructure (including health, education, and transport infrastructure).

Economic activities

The schedule adds the economic dimension to the general characteristics by seeking information on various economic activities in the village. It covers the main economic activities and resources of the village, and thus complements the household-level economic data.

Education

The schedule obtains information on the inventory of the educational facilities in the village (number and type of schools, classes and teachers) and indicators of quality (educational qualifications of teachers, teachers' credentials and attendance).

This information complements the enrollment and attendance data collected in the household schedule. Information on enrollment rate and drop-out rate in the schools is also elicited.

Health

Information on the inventory of the healthcare facilities in the village (number and type of facilities and healthcare personnel) and indicators of quality (attendance of doctors and nurses) is recorded in the schedule. This information was collected from village Pradhan/Health Centre Personnel.

Transport infrastructure

The schedule seeks information on the state of the village transport infrastructure. This refers to roads that connect or pass through the village, their condition, distance from the national highway and state highway, distance to railway station and waterways (where applicable), and the extent of available transport services available. Information was also sought on difficulties experienced by the villagers due to the poor quality of infrastructure and transport services.

Markets

The effect of road projects on the accessibility of markets is a critical factor in bringing about changes in the pattern and level of income. The schedule obtains information on the frequency and type of markets.

Prices

Changes in transport costs brought about by road projects are likely to affect prices of tradable goods. The schedule records information on the prices of different commodities in the market inside the village or in the nearby village/town.

Government programmes

There is every likelihood that the improvement in road infrastructure would result in better coverage and would in turn enhance the quality of various development programmes. Hence, information was sought on the number and type of such programmes operating in the village and the extent to which they are availed of by the residents (benefits accrued to the residents).

Land use

Change in land use pattern is regarded as a major impact of road transport development. As such, the schedule seeks village-wise information on land use pattern. It also elicits information on the cropping pattern, price of land and tenancy pattern.

Community activities

The schedule aims to provide an overview of the social and potential events and activities in the village. The increased mobility and communication resulting from better road connectivity may well have measurable social capital effects on villages, which this schedule attempts to capture. This section complements the household survey schedule, which covers the household participation in community affairs.

Method of enquiry

Considering the complexity of the subject matter, the necessity of obtaining complete and consistent data and the advantages and limitations of various methods of enquiry, it was considered appropriate to use the interview method or a combination of interview and observation methods for the household enquiry.

Data input

The data was stored in the electronic form using the software MS ACCESS & SPSS. Further tabulation for analysis was done in the MS EXCEL format after appropriate mapping from MS ACCESS.

Annex 1

Socio-economic profile of the basic strata

Variable		Basic strata							Overall
		I	II	III	IV	V	VI	VII	
1.	Percentage of child population (0-6 years)	21.14	19.93	19.63	21.37	21.45	22.07	22.56	21.17
2.	Number of females per thousand males	827.66	818.89	868.59	899.07	881.7	942.85	991.09	884.83
3.	Percentage of scheduled caste/ scheduled tribe population	23.71	33.52	26.76	24.03	23.63	35.67	21.31	27.21
4.	Percentage of literates	35.05	43.43	41.27	33.10	34.72	25.42	23.18	33.72
5.	Percentage of main workers from total population	27.50	27.81	32.33	31.09	28.87	33.00	28.20	30.16
6.	Percentage of working population (main + marginal)	27.70	27.83	35.98	33.99	30.31	34.68	34.52	32.19
7.	Percentage of cultivators from main workers	50.96	55.07	54.09	37.99	42.64	47.42	62.36	47.81
8.	Percentage of agricultural labourers from main workers	22.56	26.90	26.76	37.09	43.74	43.20	18.62	33.35
9.	Percentage of fishing and livestock workers from main workers	0.56	0.75	1.12	0.54	0.19	0.03	0.53	0.50
10.	Percentage of mining and quarrying workers from main workers	0.01	0.00	0.02	0.18	0.02	0.07	0.32	0.08
11.	Percentage of manufacturing workers (household industry) from main workers	0.72	0.76	1.41	4.79	0.99	1.35	1.73	1.95
12.	Percentage of manufacturing workers in non-household industry from main workers	12.83	2.83	2.71	3.60	0.77	0.40	0.50	3.68
13.	Percentage of construction workers from main workers	1.00	0.88	0.96	2.49	0.32	0.17	0.36	1.03
14.	Percentage of trade and commerce from main workers	3.31	3.07	3.72	3.13	2.81	0.53	1.37	2.57
15.	Percentage of transport and communication workers from main workers	1.40	1.17	1.33	3.35	0.31	0.11	0.74	1.37
16.	Percentage of workers engaged in other services from main workers	6.66	8.58	7.88	6.83	8.22	6.71	2.86	7.03

Source: Census of India, 1991.

Availability of basic amenities

Sl. No	Facility	Basic strata							Overall
		I	II	III	IV	V	VI	VII	
Educational facilities									
1.	Educational institution	70.78	75.93	81.18	53.01	66.14	53.00	66.39	63.46
i.	Primary school	65.02	66.67	70.59	47.89	63.39	49.40	61.34	58.04
ii.	Middle school	12.35	20.99	18.24	7.83	16.14	8.63	7.56	12.20
iii.	High school	3.70	4.94	2.35	0.90	4.33	3.36	5.04	3.24
iv.	PU college	2.88	4.32	2.94	0.90	0.00	0.00	0.00	1.30
v.	Graduate college	0.00	0.00	0.00	0.30	0.79	0.72	0.00	0.35
vi.	Adult literacy centre	0.82	0.62	22.94	7.23	0.39	0.00	0.00	3.95
vii.	Industrial school	0.00	0.00	0.59	0.00	0.00	0.00	0.00	0.06
viii.	Training school	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ix.	Other school	0.41	0.00	0.00	11.75	1.18	4.56	5.04	4.01
Health facilities									
2.	Medical institution	99.18	100.00	32.94	100.00	13.39	16.07	15.97	53.68
i.	Hospital	2.88	0.00	2.94	2.11	1.18	0.48	1.68	1.53
ii.	Maternity and child welfare centre	3.70	10.49	5.88	3.92	0.39	0.00	2.52	3.12
iii.	Maternity home	0.41	0.00	1.18	0.30	0.00	0.48	0.84	0.41
iv.	Child welfare centre	9.05	0.62	8.24	1.81	0.00	0.96	1.68	2.89
v.	Primary health centre	0.82	3.70	7.06	3.31	1.18	2.40	2.52	2.77
vi.	Health centre	2.88	0.00	2.94	2.11	1.18	0.48	1.68	1.53
vii.	Primary health sub-centre	0.82	0.00	2.35	19.88	7.48	5.76	4.20	7.07
viii.	Dispensary	1.23	0.62	1.76	0.30	0.39	1.44	0.84	0.94
ix.	Family planning centre	4.53	0.62	2.35	0.00	2.36	2.40	2.52	2.06
x.	Tuberculosis clinic	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.06
xi.	Nursing home	0.41	0.00	0.59	0.30	0.00	0.24	0.00	0.24
xii.	Community health workers	82.30	87.65	9.41	72.89	0.39	0.24	0.00	35.47
xiii.	Registered private practitioners	2.47	1.23	7.06	2.41	0.00	0.00	0.00	1.65
xiv.	Subsidiary medical practitioners	0.00	0.00	0.00	0.00	3.15	4.56	6.72	2.06
xv.	Other medical centres	0.00	0.62	0.59	0.30	0.00	0.24	0.00	0.24
Drinking water facilities									
3.	Drinking water	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
i.	Tap water	38.27	72.84	19.41	8.73	1.97	0.48	1.68	16.62
ii.	Well water	44.44	27.16	81.18	85.54	100.00	99.28	100.00	80.20
iii.	Tank water	0.00	0.00	14.12	18.07	17.32	11.27	56.30	14.26
iv.	Tube-well water	6.17	0.00	7.65	25.90	15.35	8.87	2.52	11.37
v.	Hand pump	65.43	27.16	65.29	74.10	98.03	91.37	87.39	76.25
vi.	River water	33.74	72.84	3.53	3.31	14.57	18.71	39.50	22.33
vii.	Fountain water	33.74	72.84	1.18	0.30	0.00	0.96	3.36	12.43
viii.	Canal	0.00	0.00	0.59	13.55	13.39	13.19	2.52	8.13
ix.	Nala	0.00	0.00	0.00	1.51	0.79	8.63	16.81	3.71
x.	Other drinking water sources	0.00	0.00	0.00	0.30	0.00	0.96	3.36	0.53
Post and telegraph facilities									
4.	Post and telegraph facilities	10.70	22.84	12.35	10.24	12.60	10.07	14.29	12.32
i.	Post office	10.29	22.84	18.24	10.84	11.02	8.87	11.76	12.26
ii.	Telegraph office	0.00	0.62	2.94	0.60	0.00	0.00	0.00	0.47
iii.	Post and telegraph office	0.41	0.00	2.35	0.00	1.57	1.20	1.68	0.94
iv.	Telephone connections	0.00	0.62	0.59	0.00	1.18	0.00	0.00	0.29
Transport connectivity									
5.	Communication facilities	24.28	7.41	26.47	34.04	12.60	18.47	20.17	21.33
i.	Bus stop	24.28	7.41	28.24	33.73	12.60	18.47	20.17	21.45
ii.	Taxi/ tempo stand	0.00	0.00	6.47	0.00	0.00	0.00	0.00	0.65
iii.	Railway station	0.82	0.00	4.12	0.00	1.97	0.00	0.00	0.82

Contd. ...

Sl. No	Facility	Basic strata							Overall
		I	II	III	IV	V	VI	VII	
Approach to village									
iv.	Pucca road	37.45	40.74	30.59	56.02	14.57	27.34	28.57	34.18
v.	Katcha road	59.26	58.64	70.59	55.42	93.70	99.28	84.87	76.37
vi.	Navigable river	0.00	0.00	8.82	1.20	0.00	2.16	2.52	1.83
vii.	Navigable canal	0.00	0.00	0.59	0.30	1.18	0.00	0.00	0.29
viii.	Footpath	3.70	0.62	34.12	12.05	0.00	0.00	7.56	6.89
Power supply									
6.	Power supply	83.95	51.23	85.29	90.06	83.07	46.76	33.61	69.36
i.	Power supply for domestic purpose	30.04	35.80	44.12	62.35	22.44	1.20	14.29	28.99
ii.	Power supply for agriculture	60.08	29.01	42.35	48.80	72.05	27.58	8.40	43.31
iii.	Power supply for industrial/ commercial purpose	2.06	0.00	0.00	0.00	0.39	0.48	1.68	0.59
iv.	Power for all purposes	25.93	3.09	28.24	17.77	10.63	17.51	11.76	17.03
Irrigation facilities									
7.	Irrigation facilities by								
i.	Well without electricity	0.78	0.01	0.52	0.00	5.69	11.53	30.64	4.00
ii.	Well with electricity	1.66	2.45	0.32	0.29	28.60	2.98	1.88	5.10
iii.	Tube-well with electricity	13.40	14.75	23.79	0.25	4.54	6.89	4.20	9.86
iv.	Tube-well without electricity	54.87	9.71	30.62	0.89	14.03	1.20	0.15	19.25
v.	Government canal	29.11	71.83	41.82	98.57	33.82	19.52	8.99	46.31
vi.	Private canal	0.00	0.42	0.00	0.00	0.36	3.05	2.17	0.77
vii.	River irrigation	0.05	0.00	0.00	0.00	1.61	2.91	17.31	1.17
viii.	Tank irrigation	0.00	0.07	2.25	0.00	3.43	10.03	15.67	3.18
ix.	Other source	0.13	0.75	0.69	0.00	7.92	41.89	18.99	10.35
Market facilities									
8.	Availability of market facilities	3.29	4.94	5.88	3.31	1.18	5.76	12.61	4.66

Source: Census of India, 1991.

Annex 2

Note on Determination of Sample Size

The prime objective of a sample survey is to make estimates of certain values for a population using the observations obtained from the limited number of units (sample) of the population. The accuracy of the survey estimate is generally taken to mean the closeness of the estimate to an exact or true value. The true value, which is always unknown, is the value that would be obtained if data would be collected and processed, without error, for all units in the population. The error of a particular estimate is the difference between the estimate and the true value of the quantity being estimated. This type of error arises from the fact that the operation is confined to a sample of population rather than the whole population. The statistical concept refers to this deviation of the estimate from the true value it is supposed to estimate as sampling error. Most of the methods of determination of sample size are associated with the expected margin of uncertainty of the estimate from its true value, expressed generally in terms of 'permissible margin'.

In planning a sample survey for estimating the population parameters, it is important to determine the size of a sample. It is well known that in a simple random sample of size *n*, the sample mean is an unbiased estimator of the population mean. The standard deviation of the mean is inversely proportional to the square root of sample size, $\sigma/\sqrt{n}$. This measure is indicative of the sampling error. Clearly, the sampling error decreases with increase in the sample size. But the increase in the sample size involves additional cost of investigation. There, thus, is a (negative) trade-off between precision to be attained, in other words reduction in sampling error and higher cost of sample survey.

The size of the sample can be determined by specifying the degree of risk in terms of permissible loss of accuracy and the level of confidence. A generalised solution for the estimation of a sample size is as follows:

- Let *z* be the amount of error by taking the estimate and let *l* (*z*) be the loss incurred by taking it. For a given sampling method, the theory will provide the density function. Thus, the expected value of the loss for a given sample size is obtained by:

$$L(n) = E[l(z)] \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

- In its most simplified form, the cost function for a sample of size *n* can be denoted by

  $$C(n) = a+cn \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

  where *a* is the over-head cost, and *c* is the cost per unit in the sampling method.

- By combining equations (1) and (2), we get the total loss which is given by:

  $$\phi(n) = L(n) + \lambda C(n) \quad \ldots\ldots\ldots (3)$$

  where λ is some constant quantity.

- Since the purpose in taking the sample is to minimise the total loss, *n* should be so chosen that equation (3) is minimised. By differentiating $\phi(n)$ with respect to *n* and equating $\partial \phi / \partial n = 0$, the optimum value of *n* can be determined.

Thus, the optimum sample size is constrained by cost considerations and the nature of important variable to be estimated, its co-efficient of variation, the desired accuracy of measurement together with the level of significance associated to it. Once these factors are known, the sample size (n) may be computed by the following formula.

$$n = CV^2 Z_\alpha{}^2 / E^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

where CV is the co-efficient of variation, E is the level of accuracy (expressed as a proportion) and Z_α is the value of the standard normal variate for the confidence level (α) required[2].

Since in the present case, CV was not known before the sample survey was conducted, various sample sizes were estimated, using different sampling proportions. It was considered that a sampling fraction of around 12 percent covering 3200 households would adequately represent the total population. In the case of two-stage design, as the variability between the first stage units would be more pronounced than the variability within the first stage units, specific advantages would accrue in selecting a higher number of first stage units and spreading the sample households comparatively thinly over them. This consideration weighed in the choice of 200 first stage units and 16 second stage units per first stage unit.

2. See Sith (1979).

Annex 3

List of sample villages

S. No.	Census code 1991	Name of the village	Block	District	State
1	210030008000150158	Dharmai	Araon	Firozabad	Uttar Pradesh
2	210030008000160159	Sarai Haibatpur	Araon	Firozabad	Uttar Pradesh
3	210030008000160162	Kithaut	Araon	Firozabad	Uttar Pradesh
4	210030008000160163	Karahara	Araon	Firozabad	Uttar Pradesh
5	210030008000170172	Shekhupur	Araon	Firozabad	Uttar Pradesh
6	210010002000150135	Mondha	Firozabad	Firozabad	Uttar Pradesh
7	210010002000160148	Jahangirpur	Firozabad	Firozabad	Uttar Pradesh
8	210010002000160153	Nurpur Kutubpur	Firozabad	Firozabad	Uttar Pradesh
9	210010002000170170	Matsena	Firozabad	Firozabad	Uttar Pradesh
10	210030007000010005	Dargapur-Mohanipur	Firozabad	Firozabad	Uttar Pradesh
11	210020005000140168	Lalai	Khergarh	Firozabad	Uttar Pradesh
12	210020005000150175	Dhunpai	Khergarh	Firozabad	Uttar Pradesh
13	210020005000160190	Keshopur	Khergarh	Firozabad	Uttar Pradesh
14	210020005000160191	Prathavipur	Khergarh	Firozabad	Uttar Pradesh
15	210020005000170207	Hasanpur Garia	Khergarh	Firozabad	Uttar Pradesh
16	210030009000190199	Ujraikhera	Madanpur	Firozabad	Uttar Pradesh
17	210030009000220223	Bithauli	Madanpur	Firozabad	Uttar Pradesh
18	210030009000220227	Bachhmai	Madanpur	Firozabad	Uttar Pradesh
19	210030009000220230	Naglator	Madanpur	Firozabad	Uttar Pradesh
20	210030009000270272	Sujanipur	Madanpur	Firozabad	Uttar Pradesh
21	210030009000280286	Semra Atikabad	Madanpur	Firozabad	Uttar Pradesh
22	210030007000010002	Jinjauli	Shikohabad	Firozabad	Uttar Pradesh
23	210030007000010004	Naoli	Shikohabad	Firozabad	Uttar Pradesh
24	210030007000020014	Mohamdpur Labhna	Shikohabad	Firozabad	Uttar Pradesh
25	210030007000020019	Dewaechi	Shikohabad	Firozabad	Uttar Pradesh
26	210030007000020024	Maiyamai	Shikohabad	Firozabad	Uttar Pradesh
27	210030007000020026	Shaijalpur	Shikohabad	Firozabad	Uttar Pradesh
28	210030007000030030	Basudeomai	Shikohabad	Firozabad	Uttar Pradesh
29	210030007000030032	Nagla Saidlal	Shikohabad	Firozabad	Uttar Pradesh
30	210030007000040046	Bakalpur	Shikohabad	Firozabad	Uttar Pradesh
31	210030007000050050	Jaslai	Shikohabad	Firozabad	Uttar Pradesh
32	210030007000050053	Mohabatpur Ahir	Shikohabad	Firozabad	Uttar Pradesh
33	210030007000050056	Jahagirpur Gulrai	Shikohabad	Firozabad	Uttar Pradesh
34	210030007000010001	Makhanpur	Sikohabad	Firozabad	Uttar Pradesh
35	210010002000170163	Undani	Friozabad	Friozabad	Uttar Pradesh
36	350040012000100074	Ailchipur	Ajitmal	Auraiya	Uttar Pradesh
37	350040012000110086	Shekhupur Jainpur	Ajitmal	Auraiya	Uttar Pradesh
38	350040012000120093	Bahadurpur Uncha	Ajitmal	Auraiya	Uttar Pradesh
39	350040012000130106	Purwadori	Ajitmal	Auraiya	Uttar Pradesh
40	350040012000130109	Jagatpur	Ajitmal	Auraiya	Uttar Pradesh
41	350040012000130110	Turkipur Bhagwandas	Ajitmal	Auraiya	Uttar Pradesh
42	350040014000310275	Akbarpur	Auraiya	Auraiya	Uttar Pradesh
43	350040014000350316	Takpura	Auraiya	Auraiya	Uttar Pradesh
44	350040014000360324	Hasuliya	Auraiya	Auraiya	Uttar Pradesh
45	350040014000370332	Parariya	Auraiya	Auraiya	Uttar Pradesh
46	350040014000370333	Garha Manik Chandra	Auraiya	Auraiya	Uttar Pradesh
47	350040014000370334	Salaiya	Auraiya	Auraiya	Uttar Pradesh
48	350040014000380342	Tilakpur	Auraiya	Auraiya	Uttar Pradesh
49	350040014000380344	Inguthiya	Auraiya	Auraiya	Uttar Pradesh

50	350040014000380348	Rajandajpur	Auraiya	Auraiya	Uttar Pradesh
51	350040014000390354	Sainpur	Auraiya	Auraiya	Uttar Pradesh
52	350040014000390362	Rautiyapur	Auraiya	Auraiya	Uttar Pradesh
53	350040014000420392	Bamuripur	Auraiya	Auraiya	Uttar Pradesh
54	350040014000420394	Narottampur	Auraiya	Auraiya	Uttar Pradesh
55	350040014000420397	Kakhantoo	Auraiya	Auraiya	Uttar Pradesh
56	350040013000230222	Sherpur Sariya	Bhagya Nagar	Auraiya	Uttar Pradesh
57	610050019000290480	Dundra	Devmai	Fatehpur	Uttar Pradesh
58	610050019000270464	Kechakpur	Malwan	Fatehpur	Uttar Pradesh
59	610050019000280471	Mawaiya	Malwan	Fatehpur	Uttar Pradesh
60	610050018000110149	Subedar Khera	Malwan	Fatehpur	Uttar Pradesh
61	610050018000110150	Habibpur	Malwan	Fatehpur	Uttar Pradesh
62	610050018000110152	Madanpur	Malwan	Fatehpur	Uttar Pradesh
63	610050018000120157	Khanpur	Malwan	Fatehpur	Uttar Pradesh
64	610050018000120159	Rari Khurd	Malwan	Fatehpur	Uttar Pradesh
65	610050018000120166	Malwan	Malwan	Fatehpur	Uttar Pradesh
66	610050018000120167	Baroora	Malwan	Fatehpur	Uttar Pradesh
67	610050018000120168	Davatpur	Malwan	Fatehpur	Uttar Pradesh
68	610050018000140199	Dharami Khera	Malwan	Fatehpur	Uttar Pradesh
69	610050018000140201	BeniHarsinghpur	Telyani	Fatehpur	Uttar Pradesh
70	610050018000140202	Ojhi Kharagsenpur	Telyani	Fatehpur	Uttar Pradesh
71	610050018000140207	Barmatpur	Telyani	Fatehpur	Uttar Pradesh
72	610050018000150224	Vahidpur	Telyani	Fatehpur	Uttar Pradesh
73	610050018000180280	Husanapur Sani	Telyani	Fatehpur	Uttar Pradesh
74	610050018000180282	Manjhupur	Telyani	Fatehpur	Uttar Pradesh
75	610050018000190301	Ghanshyampur	Telyani	Fatehpur	Uttar Pradesh
76	610050017000030037	Sangoan	Telyani	Fatehpur	Uttar Pradesh
77	610050017000040045	Sachauli	Telyani	Fatehpur	Uttar Pradesh
78	610050017000040048	Dhodhiyahi	Telyani	Fatehpur	Uttar Pradesh
79	610050017000060068	Umedpur	Telyani	Fatehpur	Uttar Pradesh
80	610050017000060070	Kandhi	Telyani	Fatehpur	Uttar Pradesh
81	610050017000060081	Udairajpur	Telyani	Fatehpur	Uttar Pradesh
82	610050017000070100	Teduhan	Barahani	Chandauli	Uttar Pradesh
83	610050017000080110	Maharani	Barhani	Chandauli	Uttar Pradesh
84	610050017000090119	Kinauli	Barhani	Chandauli	Uttar Pradesh
85	610050017000090124	Madhupur	Chandauli	Chandauli	Uttar Pradesh
86	610050017000020027	Dhurikot	Chandauli	Chandauli	Uttar Pradesh
87	610050017000060076	Jasori	Chandauli	Chandauli	Uttar Pradesh
88	610050017000080108	Bichhiya Khurd	Chandauli	Chandauli	Uttar Pradesh
89	610040016000300365	Bichhiya Kala	Chandauli	Chandauli	Uttar Pradesh
90	610040016000300376	Majhwar Khas	Chandauli	Chandauli	Uttar Pradesh
91	610040016000310385	Negura	Chandauli	Chandauli	Uttar Pradesh
92	610040016000320413	Nawahi	Chandauli	Chandauli	Uttar Pradesh
93	610040016000340433	Marhar	Chandauli	Chandauli	Uttar Pradesh
94	610040016000340439	Bhadalpura	Chandauli	Chandauli	Uttar Pradesh
95	610040016000350445	Fatehpur	Chandauli	Chandauli	Uttar Pradesh
96	610040016000350457	Mathpurawa	Chandauli	Chandauli	Uttar Pradesh
97	610040016000380487	Bahera	Chandauli	Chandauli	Uttar Pradesh
98	610050017000020021	Miradadpur	Chandauli	Chandauli	Uttar Pradesh
99	610040016000330420	Urgawan	Chandauli	Chandauli	Uttar Pradesh
100	430010001000050061	Sohadwar	Chandauli	Chandauli	Uttar Pradesh
101	430010002000090104	Jalalapur	Niamatabad	Chandauli	Uttar Pradesh
102	430010002000100119	Dihawa	Niamtabad	Chandauli	Uttar Pradesh
103	430010002000120136	Chakiya	Niamtabad	Chandauli	Uttar Pradesh
104	430010002000120138	Mannapur	Niamtabad	Chandauli	Uttar Pradesh
105	430010002000130153	Dariyapur	Niamtabad	Chandauli	Uttar Pradesh

106	430010002000150179	Hamidpur	Niamtabad	Chandauli	Uttar Pradesh
107	430010002000150183	Bharchha	Niamtabad	Chandauli	Uttar Pradesh
108	430010002000160196	Godhna	Niamtabad	Chandauli	Uttar Pradesh
109	430010002000160199	Kharagipur	Niamtabad	Chandauli	Uttar Pradesh
110	430010002000170210	Rohara	Niamtabad	Chandauli	Uttar Pradesh
111	430010002000170212	Hinauni	Niyantabad	Chandauli	Uttar Pradesh
112	430020005000010002	Jiwadhipur	Niyantabad	Chandauli	Uttar Pradesh
113	430020005000010004	Mahewa	Niyantabad	Chandauli	Uttar Pradesh
114	430020005000010007	Sai	Sakal Diha	Chandauli	Uttar Pradesh
115	430020005000020013	Khuchama	Sakal Diha	Chandauli	Uttar Pradesh
116	430020005000030031	Kakarahi Kala	Sakal Diha	Chandauli	Uttar Pradesh
117	430020005000030033	Basaratiya	Sakal Diha	Chandauli	Uttar Pradesh
118	430020005000040036	Sevakhar Khurd	Sakal Diha	Chandauli	Uttar Pradesh
119	430020005000040042	Farsand Mohanpur	Sakal Diha	Chandauli	Uttar Pradesh
120	430020005000070076	Bahorikpur	Sakal Diha	Chandauli	Uttar Pradesh
121	430020005000070080	Madhuban	Sakal Diha	Chandauli	Uttar Pradesh
122	430020005000090089	Nadara	Sakal Diha	Chandauli	Uttar Pradesh
123	430020005000090090	Muhammadpur	Sakal Diha	Chandauli	Uttar Pradesh
124	430020005000100102	Gaherpura	Sakaldiha	Chandauli	Uttar Pradesh
125	040060006000600247	Monihari	Bhabhua	Bhabhua	Bihar
126	040060006000600526	Kushihara	Bhabhua	Bhabhua	Bihar
127	040060006000600556	Timara Ghat	Bhabhua	Bhabhua	Bihar
128	040060006000600560	Panshi	Bhabhua	Bhabhua	Bihar
129	040060006000600565	Natti	Bhabhua	Bhabhua	Bihar
130	040060006000600566	Dughara	Bhabhua	Bhabhua	Bihar
131	040060006000600576	Kathaura	Bhabhua	Bhabhua	Bihar
132	040060006000600581	Khanethi Gurudas	Bhabhua	Bhabhua	Bihar
133	040060006000600587	Miria	Bhabhua	Bhabhua	Bihar
134	040060006000600636	Mohuat	Bhabhua	Bhabhua	Bihar
135	040060006000600554	Machiwan	Kaimer	Bhabhua	Bihar
136	040070007000700621	Nado Khar	Kudra	Bhabhua	Bihar
137	040070007000700622	Sonawan	Kudra	Bhabhua	Bihar
138	040070007000700645	Patti	Kudra	Bhabhua	Bihar
139	040070007000700647	Aharauliya	Kudra	Bhabhua	Bihar
140	040070007000700648	Patkhaulia	Kudra	Bhabhua	Bihar
141	040070007000700659	Sakri	Kudra	Bhabhua	Bihar
142	040070007000700694	Barka Nimdihra	Kudra	Bhabhua	Bihar
143	040070007000700695	Gora	Kudra	Bhabhua	Bihar
144	040080008000800126	Usari	Mohania	Bhabhua	Bihar
145	040080008000800131	Mohania	Mohania	Bhabhua	Bihar
146	040080008000800165	Bamhaurkhas	Mohania	Bhabhua	Bihar
147	040080008000800473	Baghni	Mohania	Bhabhua	Bihar
148	040080008000800489	Adhwar	Mohania	Bhabhua	Bihar
149	040080008000800128	Sadatpur	Mohania	Bhabhua	Bihar
150	040080008000800542	Pakrihar	Mohania	Bhabhua	Bihar
151	070160016001600443	Banahi	Amas	Gaya	Bihar
152	070160016001600447	Bazidpur	Amas	Gaya	Bihar
153	070160016001600448	Kurasin	Amas	Gaya	Bihar
154	070160016001600493	Komal Khap	Amas	Gaya	Bihar
155	070160016001600501	Tilaia	Amas	Gaya	Bihar
156	070160016001600520	Dharampur	Amas	Gaya	Bihar
157	070160016001600539	Mircha	Amas	Gaya	Bihar
158	070160016001600544	Rampur	Amas	Gaya	Bihar
159	070160016001600545	Bishunpur	Amas	Gaya	Bihar
160	070160016001600278	Jamura Khurd	Banke Bazar	Gaya	Bihar
161	070130013001300103	Belghoghar	Barachatti	Gaya	Bihar

162	070130013001300108	Manjhuali	Barachatti	Gaya	Bihar
163	070130013001300130	Makhdumpur	Barachatti	Gaya	Bihar
164	070130013001300139	Sonbarsa	Barachatti	Gaya	Bihar
165	070130013001300146	Dharamthan	Barachatti	Gaya	Bihar
166	070130013001300173	Kalua Khurd	Barachatti	Gaya	Bihar
167	070130013001300180	Rohi	Barachatti	Gaya	Bihar
168	070130013001300181	Bhaghar	Barachatti	Gaya	Bihar
169	070130013001300184	Mankumhari	Barachatti	Gaya	Bihar
170	070130013001300185	Bhat Bigha	Barachatti	Gaya	Bihar
171	070130013001300144	Jodha Bigha	Dobhi	Gaya	Bihar
172	070130013001300156	Bundabigha	Dobhi	Gaya	Bihar
173	070130013001300159	Kaleyanpur	Dobhi	Gaya	Bihar
174	070130013001300168	Mushehani	Dobhi	Gaya	Bihar
175	070130013001300201	Kurmawan	Dobhi	Gaya	Bihar
176	070130013001300212	Gangi	Dobhi	Gaya	Bihar
177	070140014001400781	Ghorwadih	Dobhi	Gaya	Bihar
178	070140014001400787	Darioaura	Dobhi	Gaya	Bihar
179	070140014001400805	Wari	Dobhi	Gaya	Bihar
180	070140014001400837	Marha	Dobhi	Gaya	Bihar
181	070150015001500500	Morahar	Gurva	Gaya	Bihar
182	070150015001500578	Hasanpur	Gurva	Gaya	Bihar
183	070150015001500599	Pakari	Gurva	Gaya	Bihar
184	070140014001400418	Bhikhanpur	Sherghati	Gaya	Bihar
185	070140014001400749	Kalendara	Sherghati	Gaya	Bihar
186	070140014001400756	Majhanpur	Sherghati	Gaya	Bihar
187	070140014001400773	Bhus Bhusia	Sherghati	Gaya	Bihar
188	340160016001600167	Ranichunwa	Burhi	Hazaribagh	Jharkhand
189	340160016001600142	Pipra Ghoghar	Barhani	Hazaribagh	Jharkhand
190	340160016001600166	Mahugarha	Barhani	Hazaribagh	Jharkhand
191	340160016001600072	Konra	Burhi	Hazaribagh	Jharkhand
192	340160016001600136	Malkoko	Burhi	Hazaribagh	Jharkhand
193	340040004000400050	Tuio	Barkatha	Hazaribagh	Jharkhand
194	340040004000400053	Buchai Pathauria	Barkatha	Hazaribagh	Jharkhand
195	340040004000400079	Jhurjhuri	Barkatha	Hazaribagh	Jharkhand
196	340040004000400103	Masipirhi	Barkatha	Hazaribagh	Jharkhand
197	340040004000400096	Ghanghari	Barkatha	Hazaribagh	Jharkhand
198	340040004000400109	Lemua	Barkatha	Hazaribagh	Jharkhand
199	340040004000400118	Dumardiha	Barkatha	Hazaribagh	Jharkhand
200	340160016001600123	Karma	Burhi	Hazaribagh	Jharkhand

Chapter 3

Socio-economic Profile of Rural Households

This chapter provides an overview of the temporal changes in some aggregative indicators of socio-economic development between pre- and post-upgrading of NH2 for rural households living in different districts falling in the selected stretches around the highway as revealed by the baseline and the resurvey data sets. These indicators, relating to demography, mobility, poverty, sector composition of household income and employment, ownership of assets, etc., should reflect the state or stage of development of the economy of an area. Therefore, their temporal changes, should tell us about the qualitative improvement, if any, between the time points concerned. As such, many of these indicators are essentially socio-economic parameters in the sense that their values may improve over long period with *income development* unless very strong and effective specific public policy interventions are made. Since the time-gap between the two surveys is seven years and not long, any observed improvement in indicators may *partly* be ascribed to the NH2 upgrading.

The Table 0 below gives the list of indicators used in the present analysis. It may be noted that there are 18 indicators, of which 4 are examined separately for female population to see the presence of a significant gender-specific pattern, if any, and for one the patterns for scheduled caste and scheduled tribe population have also been examined. In each case, temporal change has been examined separately for the sample of poor and non-poor households as well as for the pooled sample of households. In what follows, for every indicator, a table giving baseline and resurvey values of the indicator by stretch (district) for the poor, the non-poor and the aggregate sample of households and figure(s) showing corresponding baseline and resurvey graphs are presented and discussed. The graphs have the stretches (districts) shown along the horizontal axis (arranged in order of their position on NH2 as one moves along the highway from NW to SE) and the indicator value on the vertical axis. Also, the baseline and resurvey graphs are shown on the same figure to facilitate a visual inspection of the temporal shifts. Needless to mention, this analysis should also help to ascertain if any positive impact of NH2 upgrading has been progressive and socially inclusive.

Table 0: List of selected Indicators of socio-economic development used

Nature of indicator	Indicators examined
Socio-demographic	1. Household size 2. Sex ratio 3. Dependency ratio 4. Literacy rate 5. School enrolment rate
Health	6. Proportion of Households visiting a doctor
Expenditure pattern	7. Share of food, education and health in total consumer expenditure
Mobility	8. Per capita weekly trip rate 9. Per capita weekly trip length
Poverty	10. Percentage of poor households 11. Percentage of poor persons
Asset ownership and income composition	12. Land holding per household 13. No. of consumer durables owned per household 14. Share of income from agriculture
Employment	15. Proportion of working population 16. Proportion of working population engaged in non-agriculture

Household size

Socio-economic development affects the household size in two ways. At the first stage of development, generally there is an increase in the household size via the decline in the mortality rate compared to the fertility rate and, at an advanced stage of development, the household size decreases due to decline in the fertility rate as well.

The average household size in the states of Bihar and Uttar Pradesh has generally been higher than the national average size. In the census of 2001, while the national average was 5.3, the same was 6.4 for Uttar Pradesh and 6 for Bihar[1]. In the stretches selected on the basis of high incidence of poverty, the average household size worked out to 6.5 for Uttar Pradesh and as high as 7.6 for Bihar and Jharkhand. The poor households have a still higher size as compared to the non-poor. Indeed, in their case, the growth rate has been much higher in Bihar and Jharkhand.

Table 1: Average household size (number of family members)

Stretch	Aggregate		Poor		Non-poor	
	Baseline	Resurvey	Baseline	Resurvey	Baseline	Resurvey
Firozabad	6.1	6.6	6.6	6.8	5.8	6.5
Auraiya	5.5	6.3	6.7	7.5	5.1	5.3
Fatehpur	5.5	6.1	6.3	6.7	5.3	5.8
Chandauli	6.5	6.7	6.5	7.0	6.5	6.6
Bhabhua	7.2	8.0	6.5	8.1	7.7	7.9
Gaya	6.8	7.4	7.0	7.8	6.5	6.9
Hazaribagh	7.0	7.4	7.1	8.0	6.6	6.8
Uttar Pradesh	6.0	6.5	6.6	7.0	5.8	6.2
Bihar and Jharkhand	7.0	7.6	6.9	8.0	7.0	7.2
Total	6.4	6.9	6.7	7.4	6.2	6.6

1. As per the labour bureau survey the average rural household size is 5.8 for Bihar, 5.3 for Jharkhand and 5.9 for Uttar Pradesh. Government of India, 2010. "Report on Employment and Unemployment Survey (2009-10)", Ministry of Labour & Employment, New Delhi.

Figure 1(a): Average household size (aggregate)

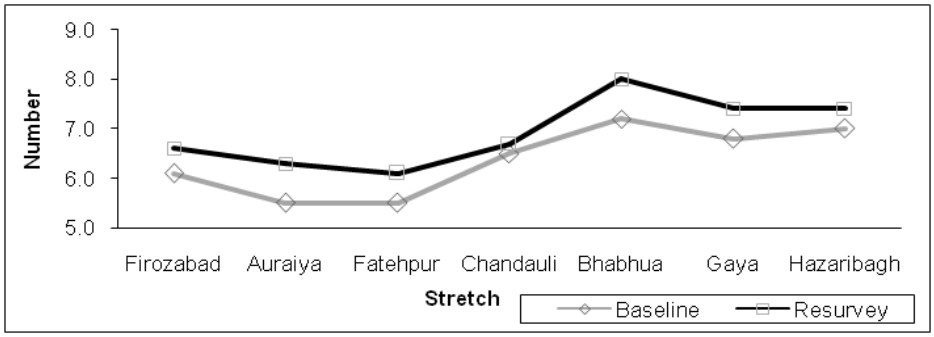


Figure 1(b): Average household size among the poor

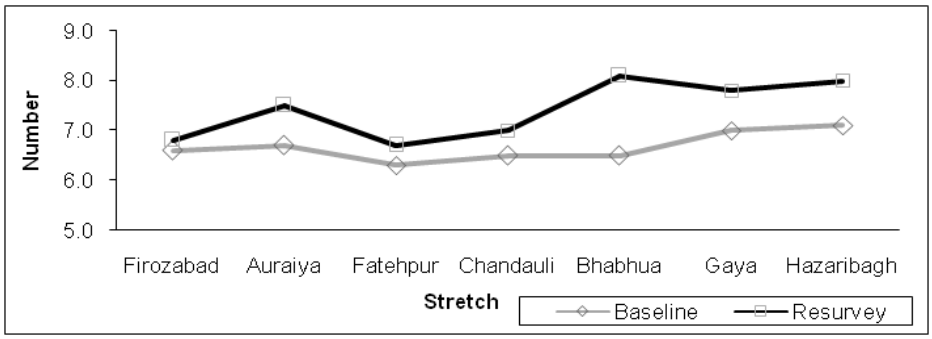
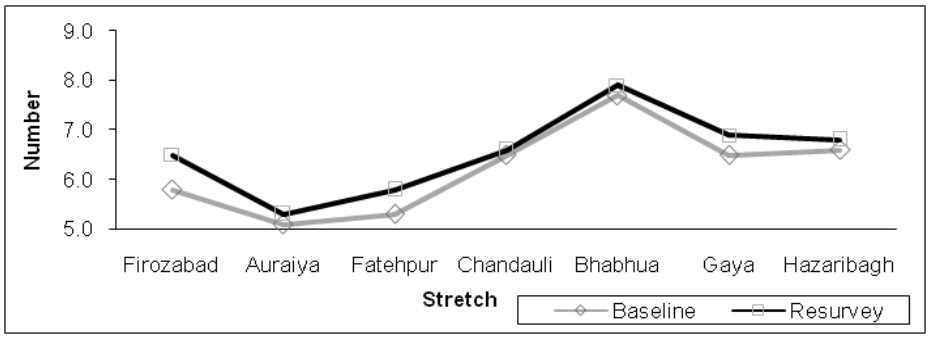


Figure 1(c): Average household size among the non-poor



Sex ratio

The sex ratio of population is one of the major indicators of the gender related status of development. The higher status and empowerment of women is expected to rise with development, as higher income gives wider opportunities and freedom to make choices. This gets reflected in the level of care a girl child receives and whether any pre-natal gender determination and foeticide takes place or not[2].

2. Dreze and Murthi (2001) argue that the increase in female foeticide is directly a reason of technological diffusion. One may argue that as the access to roads have improved; households have also gained access to quack clinics which offer pre-natal sex determination, earlier not available within the village.

The overall sex ratio (number of females per 1000 males) has remained almost the same for both the survey periods. This ratio which has been lower than the national average is better for poor households of all the three states. Arguably, better-off communities have a stronger gender bias against the female than poor households. Prevalent customs like dowry or prospect of fragmentation of land have an influence on social mores.

Table 2: Sex ratio

Stretch	Aggregate		Poor		Non-poor	
	Baseline	Resurvey	Baseline	Resurvey	Baseline	Resurvey
Firozabad	792	792	859	804	759	787
Auraiya	814	819	838	812	802	828
Fatehpur	883	795	979	827	852	777
Chandauli	872	900	863	918	876	892
Bhabhua	906	917	958	917	882	918
Gaya	889	890	924	928	853	854
Hazaribagh	927	916	936	977	912	855
Uttar Pradesh	841	835.2	875	844.2	827	830.1
Bihar and Jharkhand	902	904	935	933.3	873	880
Total	866	863.6	905	886	843	848.9

Figure 2(a): Sex ratio (aggregate)

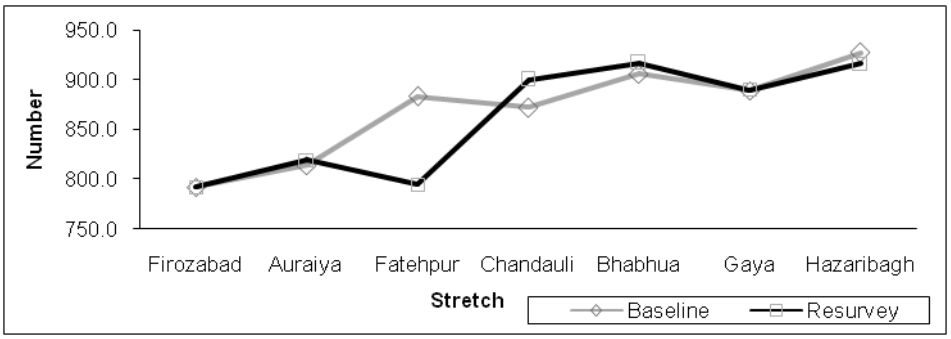


Figure 2(b): Sex ratio among the poor

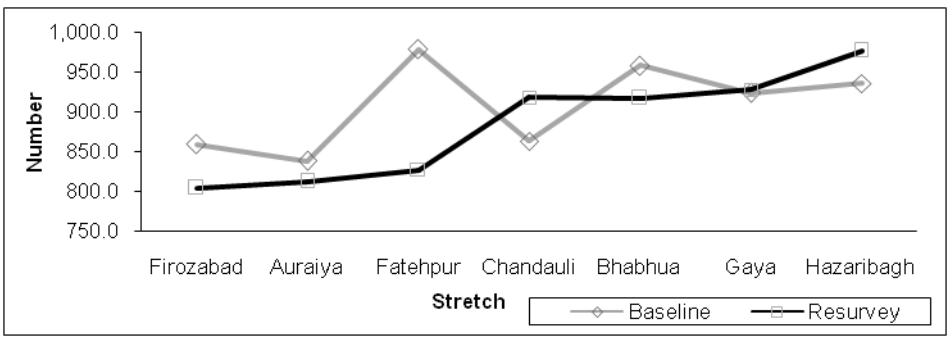
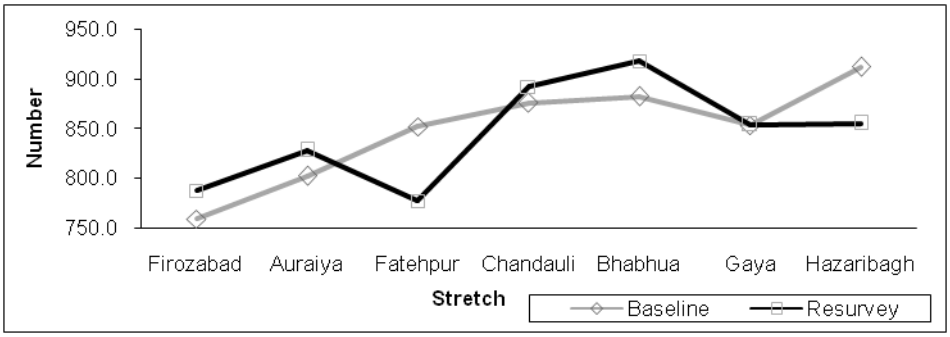


Figure 2(c): Sex ratio among the non-poor



Dependency ratio

With rise in income, the infant mortality rate tends to decline more than the adult mortality rate which, in turn, contributes to rise in dependency ratio. However, with the passage of time, the surviving larger children population would enter the working age group and reduce the dependency ratio. In the long run, when the total fertility rate gets below the replacement level and the longevity goes up due to decline in mortality in general, the dependency ratio would tend to go up.

The aggregate dependency ratio at the baseline survey (868) was higher than the national average (752 in Census 2001). This ratio significantly decreased in the resurvey (760), particularly in case of Bihar and Jharkhand. The poor have still a higher dependency ratio than the non-poor. The rate of decline in the dependency ratio among the poor in Uttar Pradesh is much faster than the poor in Bihar and Jharkhand.

Table 3: Dependency ratio

Stretch	Aggregate		Poor		Non-poor	
	Baseline	Resurvey	Baseline	Resurvey	Baseline	Resurvey
Firozabad	920	740	1102	934	836	657
Auraiya	812	703	1013	847	722	567
Fatehpur	864	677	1052	792	767	617
Chandauli	834	709	1050	970	717	614
Bhabhua	884	861	1033	1095	759	743
Gaya	875	822	977	907	735	745
Hazaribagh	887	796	958	937	753	666
Uttar Pradesh	860	711	1059	896	761	621
Bihar and Jharkhand	880	831	990	965	748	732
Total	868	760	1022	928	756	662

** Note: Dependency ratios are calculated as (T-W)/W*1000, where 'T' is the total number of persons surveyed, and 'W' is number of persons in the working-age group (15 - 59 years).*

Figure 3(a): Dependency ratio (aggregate)

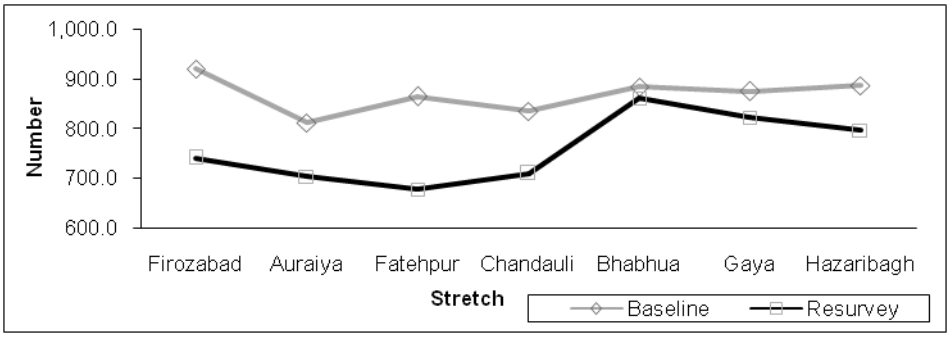


Figure 3(b): Dependency ratio among the poor

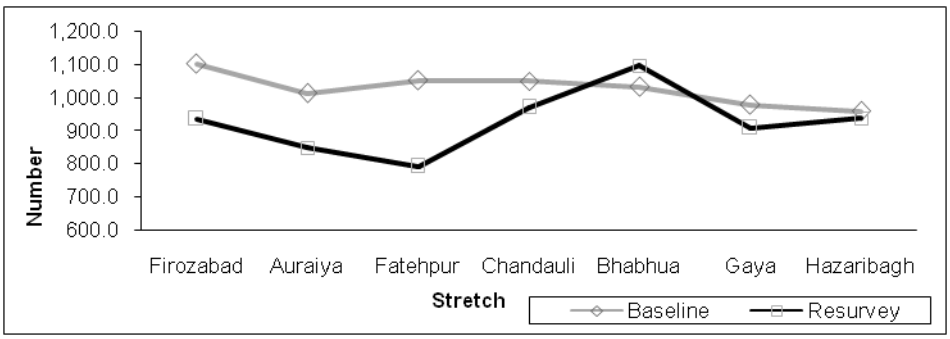
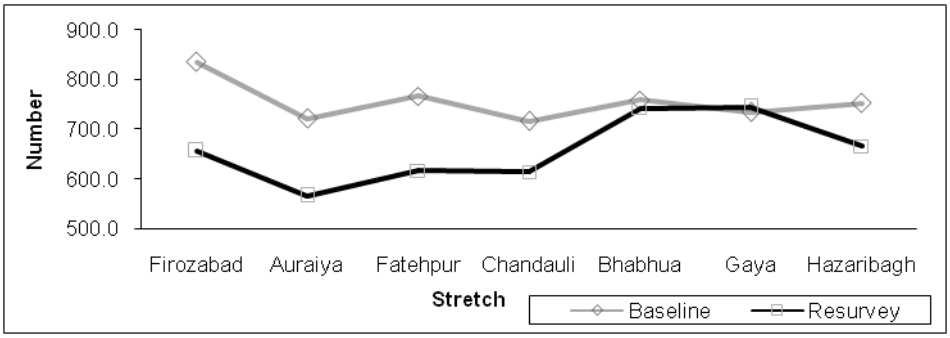


Figure 3(c): Dependency ratio among the non-poor



Literacy level

The persistence of widespread illiteracy among the disadvantaged groups tends to reinforce diverse kinds of social inequality. The expansion of basic education, thus, is seen as an essential requirement for rapid elimination of these inequalities, and for positive social change. Thus, literacy level is one of the most important indicators of human development and a vital determinant of human capabilities.

The overall literacy level (61.86 percent) has improved across all the stretches, but it is still lower than the national average of 65.38 percent (Census 2001).

However, inter-state and class differences still persist. In case of the poor households, literacy attainment is 17 percent less as compared to the non-poor households. Literacy level has gone down among the poor in Bihar and Jharkhand as compared to Uttar Pradesh. In contrast, among the non-poor, literacy level has improved in Bihar & Jharkhand as compared to Uttar Pradesh.

Table 4: Literacy level (percent)

Stretch	Aggregate		Poor		Non-poor	
	Baseline	Resurvey	Baseline	Resurvey	Baseline	Resurvey
Firozabad	58.36	66.58	53.28	59.95	61.04	69.91
Auraiya	62.55	72.03	61.83	68.03	62.93	76.49
Fatehpur	55.51	67.32	61.70	60.96	51.78	70.97
Chandauli	60.85	64.98	60.85	50.47	60.85	71.43
Bhabhua	58.91	60.60	65.26	46.35	52.72	69.26
Gaya	45.00	51.40	45.33	42.31	44.47	60.36
Hazaribagh	46.31	51.98	47.40	46.55	44.02	57.80
Uttar Pradesh	59.42	67.00	59.13	59.07	59.59	71.48
Bihar and Jharkhand	50.18	54.81	51.78	44.31	47.96	63.65
Total	55.58	61.86	55.25	51.98	55.86	68.48

Figure 4(a): Literacy level (aggregate)

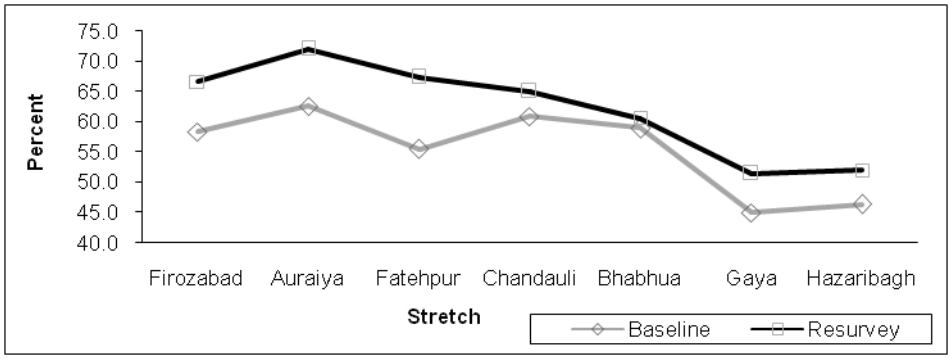


Figure 4(b): Literacy level among the poor

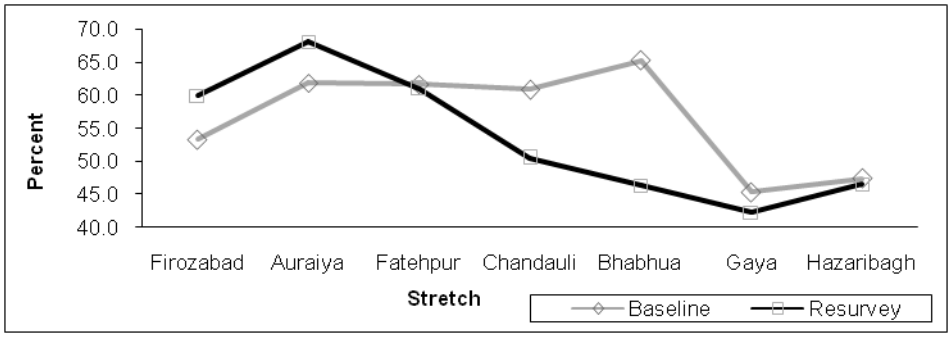
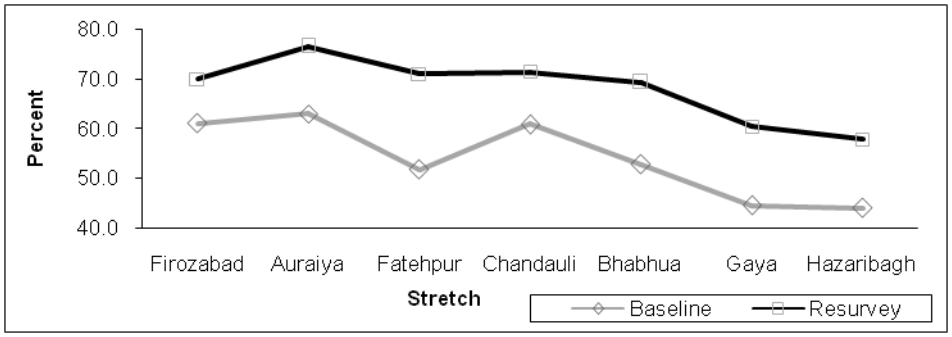


Figure 4(c): Literacy level among the non-poor



Female literacy level

Women's education has been consistently viewed not only as a benefit in itself, but as a means of achieving other development goals. The women's status and gender-related state of development is also reflected in the female literacy level and school enrolment of girls which are the fundamental factors for the development of women's awareness and their capability.

Census 2001 registered 54.16 percent female literacy. For the selected stretches, female literacy has shown considerable improvement, though it is still below the overall literacy level (male and female aggregate). The disparity between the poor and non-poor households persists. Female literacy rate among the poor households is increasing at a much faster rate than the non-poor households.

Table 5: Female literacy (percent)

Stretch	Aggregate		Poor		Non-poor	
	Baseline	Resurvey	Baseline	Resurvey	Baseline	Resurvey
Firozabad	38.19	56.39	31.57	50.95	41.63	59.15
Auraiya	48.20	66.10	44.24	62.04	50.00	70.57
Fatehpur	39.17	57.93	30.50	52.91	41.96	60.91
Chandauli	44.56	54.23	30.89	39.36	49.39	60.93
Bhabhua	46.08	51.17	30.00	36.19	53.37	60.27
Gaya	32.12	41.47	24.51	33.43	40.05	49.75
Hazaribagh	26.55	39.66	24.71	36.58	29.52	43.20
Uttar Pradesh	42.37	57.38	33.33	50.07	46.03	61.54
Bihar and Jharkhand	36.08	44.69	25.87	34.85	44.74	53.23
Total	39.73	51.89	29.34	42.55	45.57	58.30

Figure 5(a): Female literacy (aggregate)

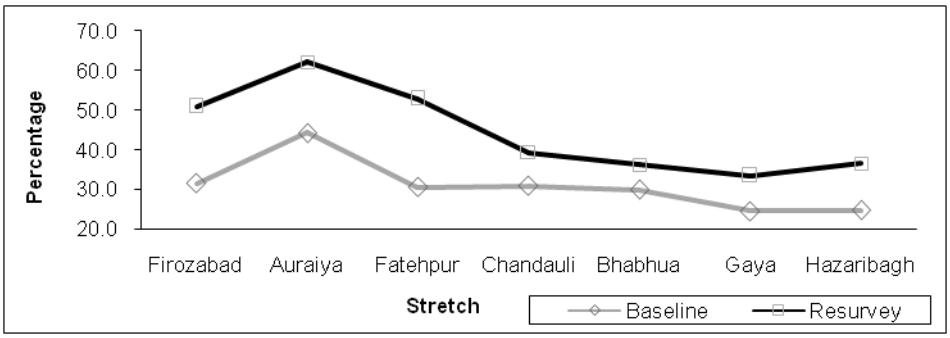


Figure 5(b): Female literacy among the poor

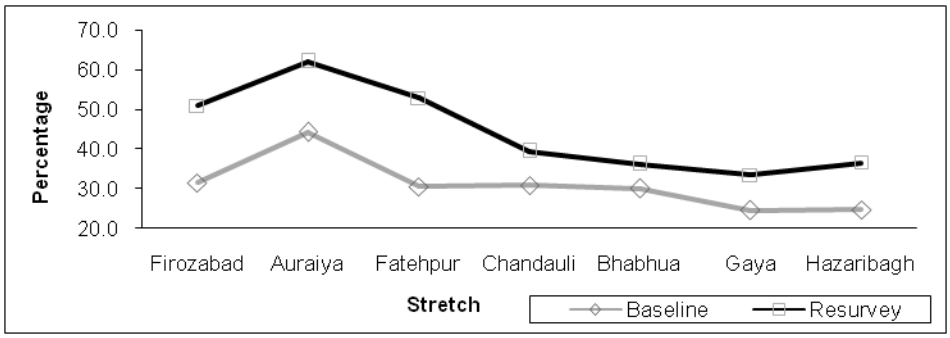
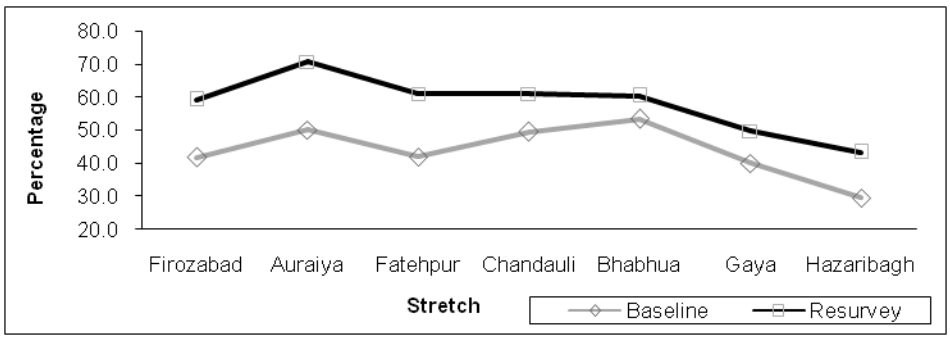


Figure 5(c): Female literacy among the non-poor



Schooling

According to the human capital theory, labour productivity in the long run is a direct function of the levels of schooling received. Higher schooling increases cognitive development and facilitates economic growth. The present analysis shows that the school enrolment among children has indicated marked increase (90.38 percent). Importantly, the poor households have also benefitted. Furthermore, the school enrolment in Bihar and Jharkhand has gone up considerably. Also, the benefit to the poor households in Bihar & Jharkhand is more pronounced as compared to the poor households in Uttar Pradesh.

Table 6: School enrolment (percent)

Stretch	Aggregate		Poor		Non-poor	
	Baseline	Resurvey	Baseline	Resurvey	Baseline	Resurvey
Firozabad	84.30	91.17	78.82	86.69	87.91	94.18
Auraiya	94.19	93.64	93.29	93.91	94.74	93.30
Fatehpur	91.47	89.16	91.12	83.98	91.72	92.81
Chandauli	88.42	91.14	81.09	84.95	93.55	94.40
Bhabhua	85.82	92.57	79.11	87.46	93.75	96.11
Gaya	68.32	86.97	61.71	81.53	80.37	92.75
Hazaribagh	76.02	89.13	72.88	84.95	83.02	94.85
Uttar Pradesh	88.67	91.16	84.14	87.20	91.75	93.91
Bihar and Jharkhand	75.77	89.35	69.24	83.99	86.32	94.43
Total	83.40	90.38	76.50	85.67	90.08	94.12

Figure 6(a): School enrolment (aggregate)

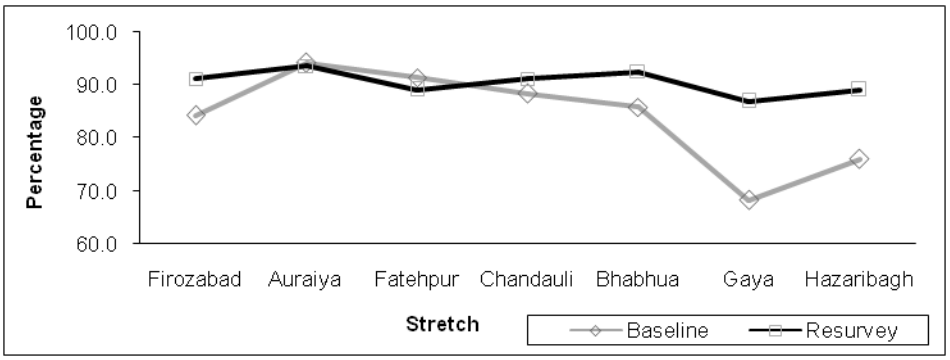


Figure 6(b): School enrolment among children of the poor

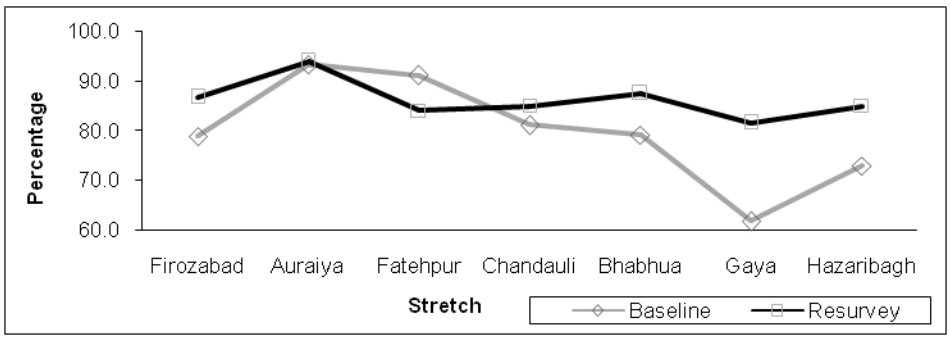
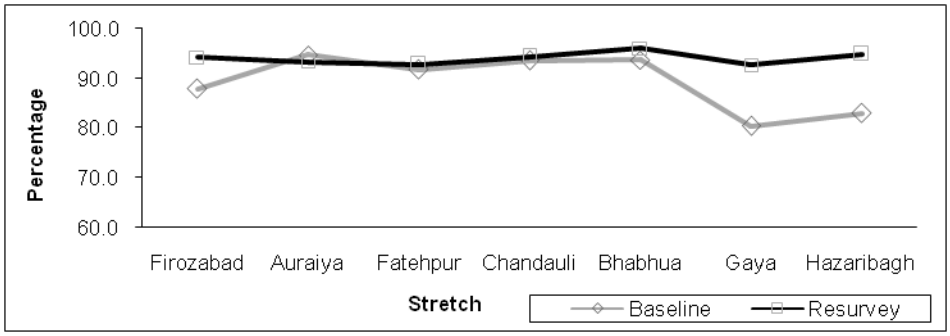


Figure 6(c): School enrolment among children of the non-poor



Schooling among girls

The individual and social returns from the women's education are believed to be exceptionally high especially where the lowering of fertility and infant and child mortality rate are concerned. In addition, rising levels of education of women lead to improvement in nutrition and healthcare facilities as also in the children's educational achievements. Prejudice against the education of girls has a strong detrimental effect on the amount of schooling they receive. Resurvey data shows a significant rise in school enrolment among girls particularly in the states of Bihar and Jharkhand. Importantly, there is also marked improvement in this regard in the case of poor households. On an aggregate, 90 percent of the girl children attend school; 84 percent even in the poor families. These are positive developments reflecting the awareness of the society towards the care of a girl child.

Table 7: Percentage of female school going children

Stretch	Aggregate		Poor		Non-poor	
	Baseline	Resurvey	Baseline	Resurvey	Baseline	Resurvey
Firozabad	77.88	89.63	72.66	83.89	81.68	93.94
Auraiya	93.88	95.70	93.94	94.64	93.85	97.30
Fatehpur	88.03	89.73	87.38	83.33	88.55	94.53
Chandauli	85.29	92.57	80.42	85.03	88.57	96.30
Bhabhua	78.34	90.36	70.52	82.27	87.94	95.50
Gaya	62.53	85.68	54.98	79.59	75.64	92.82
Hazaribagh	70.76	89.70	64.35	85.15	83.93	96.88
Uttar Pradesh	85.19	91.67	81.49	86.51	87.70	95.41
Bihar and Jharkhand	69.52	88.09	63.05	81.52	81.87	94.55
Total	78.51	90.06	71.02	84.06	85.81	95.05

Figure 7(a): Female school-going children (aggregate)

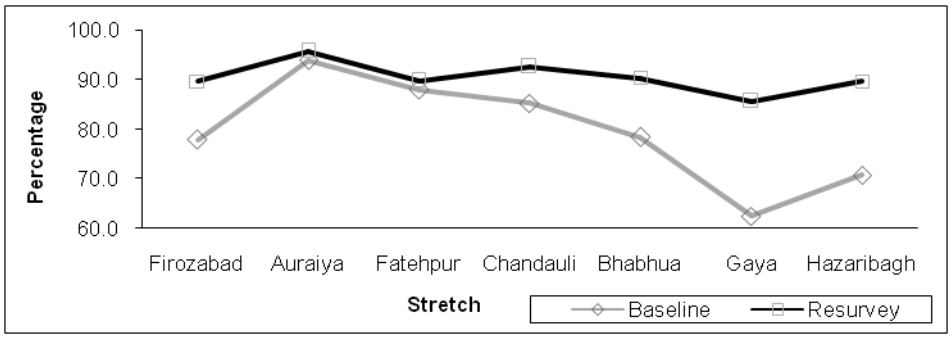


Figure 7(b): Female school-going children among the poor

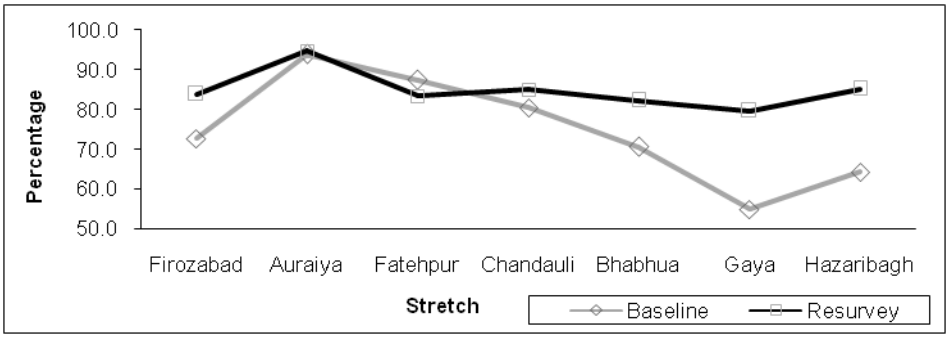
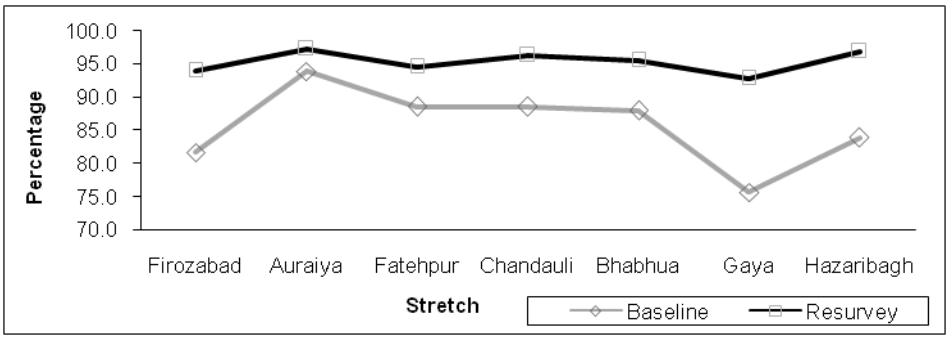


Figure 7(c): Female school-going children among the non-poor



Health and medical facilities

Access to health facilities is also one of the immediate determinants of human capabilities. In India, three major forms of inequalities have been largely responsible for the persistent and even widening differentials in health outcomes: historical inequalities, socio-economic inequalities and inequalities in the provision of and access to health services. In the resurvey, 20.07 percent of the population availed of the medical facilities as compared to 13.21 percent in the baseline survey. Higher percentage of people is availing this facility in Bihar and Jharkhand (27.93). However, the poor households are still worse off (16.26) as compared to the non-poor households (22.63). It is observed that the growth rate of the number of people visiting doctors is much higher for Bihar and Jharkhand as compared to Uttar Pradesh.

Table 8: Percentage of population availing the medical facilities

Stretch	Aggregate		Poor		Non-poor	
	Baseline	Resurvey	Baseline	Resurvey	Baseline	Resurvey
Firozabad	9.89	8.66	9.12	8.42	10.30	8.78
Auraiya	9.96	10.04	5.84	9.33	12.11	10.83
Fatehpur	13.47	9.95	10.18	10.54	15.44	9.61
Chandauli	14.05	22.91	13.26	15.85	14.56	26.05
Bhabhua	15.22	27.58	14.52	23.63	15.91	29.99
Gaya	14.21	28.88	14.05	21.70	14.46	35.94
Hazaribagh	15.25	25.96	14.27	17.95	17.31	34.54
Uttar Pradesh	12.12	14.33	10.51	11.35	13.07	16.01
Bihar and Jharkhand	14.75	27.93	14.23	21.57	15.46	33.28
Total	13.21	20.07	12.47	16.26	13.83	22.63

Figure 8(a): Percentage of population availing the medical facilities (aggregate)

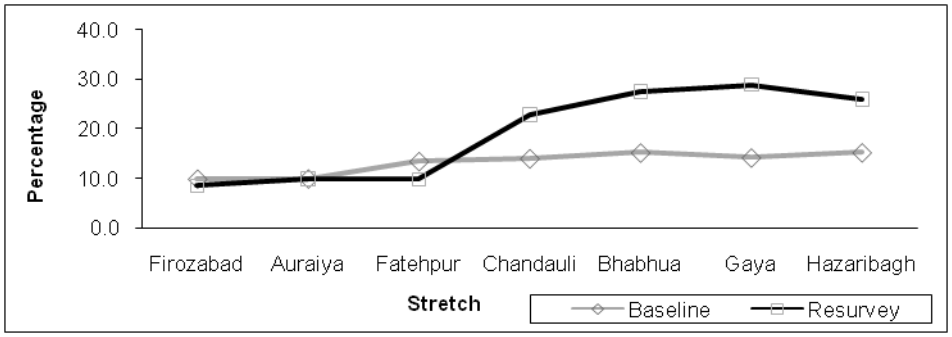


Figure 8(b): Percentage of population availing the medical facilities among the poor

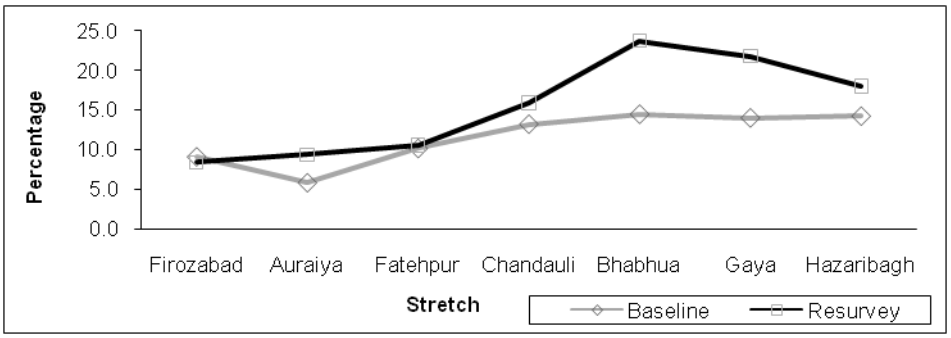
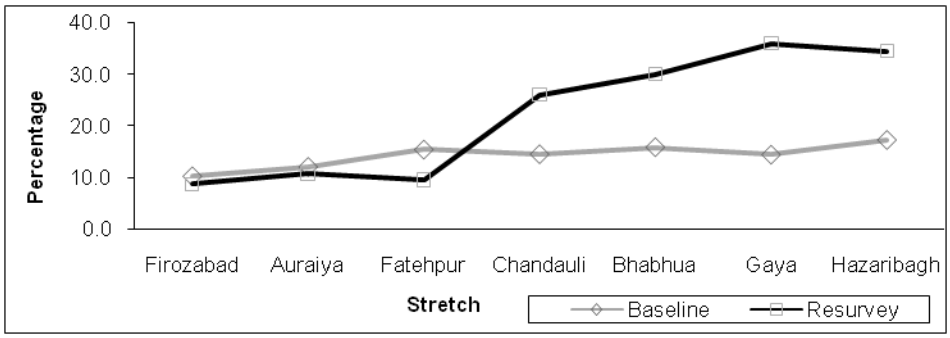


Figure 8(c): Percentage of population availing the medical facilities among the non-poor



Expenditure patterns

Economists perceive the share of food in total expenditure as an indicator of the level of consumption and the standard of living. A higher value suggests that households are mostly spending on necessities, being nearer the subsistence level, and, as such, are at a lower level of well-being.

Generally, poor people have to spend larger portion of their income on food, estimated to be about 75 percent. For the non-poor households, it is less than half of it. There are, however, spatial differences in expenditure patterns. The growth rate of share of expenditure on food is much higher for Bihar and Jharkhand, and surprisingly, for the non-poor households.

No definitive pattern has been found so far as the share of expenditure on education and healthcare is concerned.

Table 9(a): Share of expenditure on food items (percent)

Stretch	Aggregate		Poor		Non-poor	
	Baseline	Resurvey	Baseline	Resurvey	Baseline	Resurvey
Firozabad	44.62	41.65	62.44	75.83	41.38	37.27
Auraiya	41.39	44.44	60.72	70.75	37.89	36.96
Fatehpur	43.32	35.59	61.30	70.29	39.51	31.36
Chandauli	37.60	32.17	63.07	76.30	32.84	28.62
Bhabhua	30.92	36.53	64.11	77.92	24.23	31.32
Gaya	39.73	59.59	65.48	76.26	29.55	53.07
Hazaribagh	48.55	62.08	68.18	73.84	36.11	56.48
Uttar Pradesh	41.05	36.61	62.23	73.83	37.06	32.16
Bihar and Jharkhand	36.70	47.86	65.56	76.28	27.48	40.86
Total	39.38	40.28	63.86	74.98	33.60	34.79

Figure 9(a): Share of expenditure on food items (aggregate)

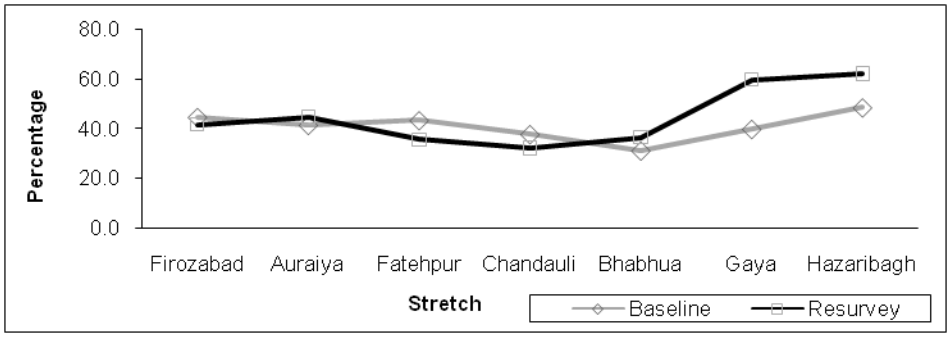


Figure 9(b): Share of expenditure on food items among the poor

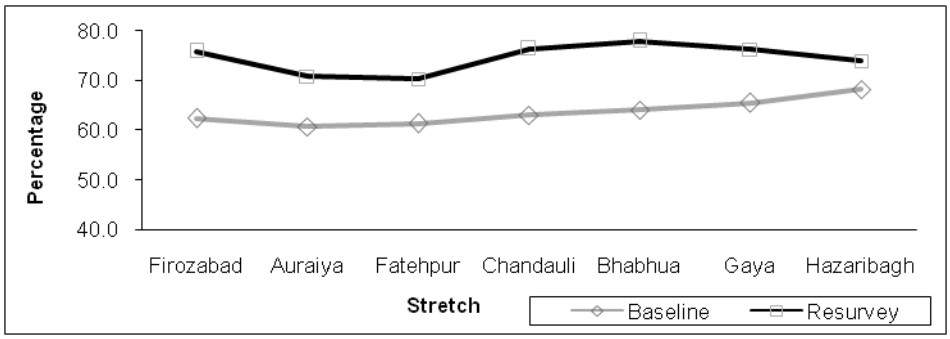


Figure 9(c): Share of expenditure on food items among the non-poor

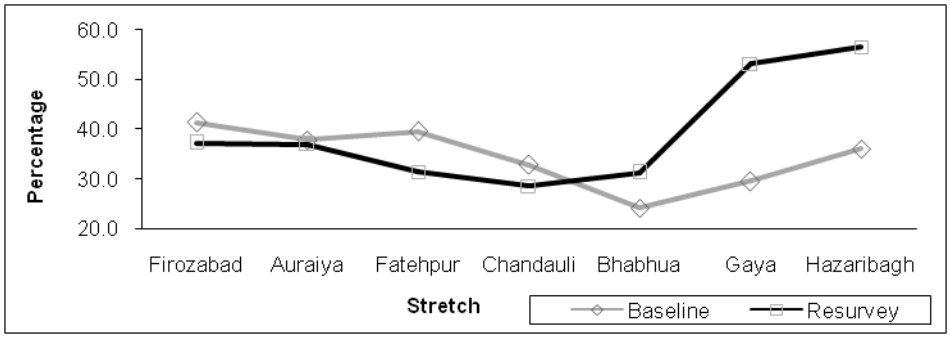


Table 9(b): Share of expenditure on education (percent)

Stretch	Aggregate		Poor		Non-poor	
	Baseline	Resurvey	Baseline	Resurvey	Baseline	Resurvey
Firozabad	4.54	2.77	4.30	3.01	4.58	2.74
Auraiya	4.41	4.10	2.74	4.57	4.72	3.96
Fatehpur	1.64	6.67	1.53	5.62	1.66	6.79
Chandauli	4.58	1.82	1.94	2.13	5.07	1.79
Bhabhua	3.82	1.93	2.33	1.49	4.12	1.98
Gaya	3.37	2.91	2.20	1.59	3.82	3.42
Hazaribagh	6.76	2.19	3.17	2.06	9.04	2.24
Uttar Pradesh	4.04	3.19	2.59	3.56	4.31	3.15
Bihar and Jharkhand	3.99	2.31	2.44	1.65	4.49	2.47
Total	4.02	2.90	2.52	2.66	4.37	2.94

Figure 9(e): Share of expenditure on education (aggregate)

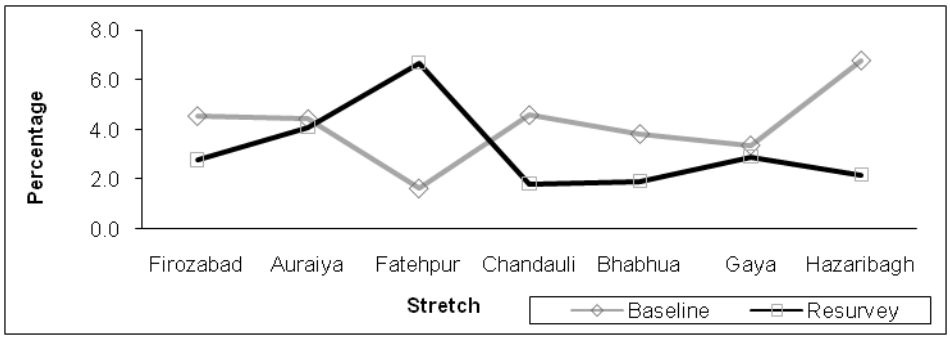


Figure 9(f): Share of expenditure on education among the poor

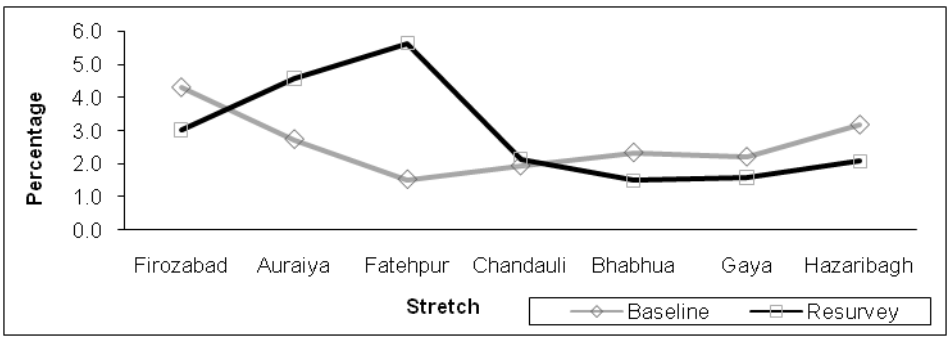


Figure 9(g): Share of expenditure on education among the non-poor

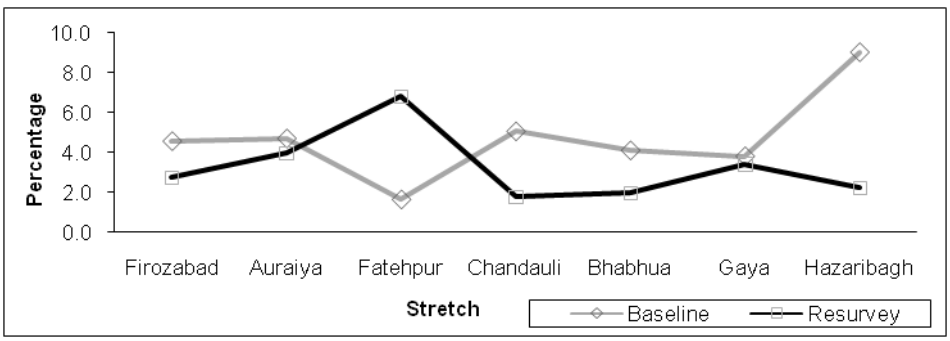


Table 9(c): Share of expenditure on health (percent)

Stretch	Aggregate		Poor		Non-poor	
	Baseline	Resurvey	Baseline	Resurvey	Baseline	Resurvey
Firozabad	3.74	1.83	3.74	2.61	3.74	1.73
Auraiya	2.43	7.54	2.23	4.38	2.47	8.44
Fatehpur	2.47	10.12	2.78	6.59	2.40	10.55
Chandauli	4.58	1.55	3.46	3.00	4.78	1.44
Bhabhua	8.36	1.50	3.83	2.58	9.27	1.36
Gaya	8.02	2.68	3.86	3.37	9.67	2.41
Hazaribagh	8.16	2.77	5.23	3.30	10.02	2.52
Uttar Pradesh	3.66	3.82	3.23	3.86	3.75	3.81
Bihar and Jharkhand	8.19	2.07	4.12	3.12	9.50	1.82
Total	5.41	3.25	3.66	3.51	5.82	3.21

Figure 9(h): Share of expenditure on health (aggregate)

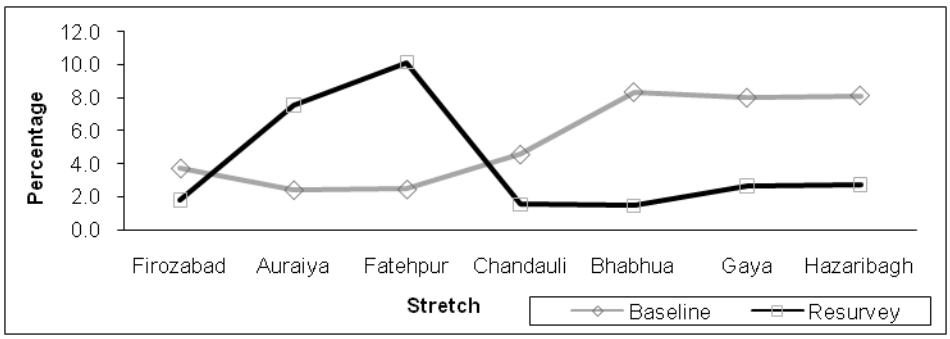


Figure 9(i): Share of expenditure on health among the poor

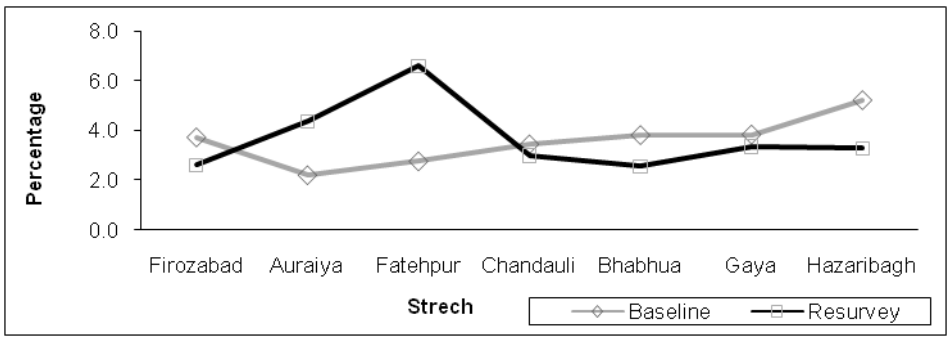
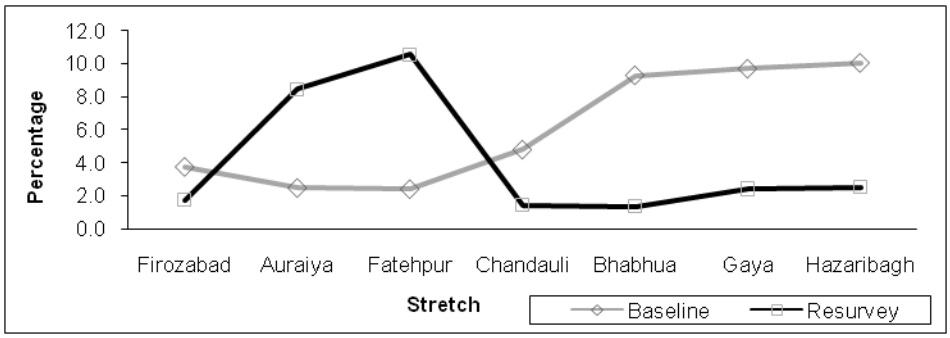


Figure 9(j): Share of expenditure on health among the non-poor



Per capita weekly trip rate

Mobility is a direct function of economic activities. Greater mobility enables people to access better facilities in terms of education, health and market and widens their job opportunities. As the economy has grown, the aggregate weekly per capita trip rate (PCTR) has also shown increase in all the stretches, particularly in the state of Bihar. Furthermore, both the poor and non-poor have benefitted from this development. Despite this, poor households continue to have lower mobility levels as compared to the non-poor households. It may be mentioned here that though the per capita trip rate is higher for Uttar Pradesh compared to Bihar and Jharkhand, the rate of growth is significantly higher in Bihar and Jharkhand.

Table 10(a): Travel characteristics – Per capita weekly trip rate

Stretch	Aggregate		Poor		Non-poor	
	Baseline	Resurvey	Baseline	Resurvey	Baseline	Resurvey
Firozabad	1.02	1.30	0.79	1.09	1.15	1.41
Auraiya	1.04	1.12	0.89	0.85	1.11	1.43
Fatehpur	0.89	1.19	0.76	1.02	0.97	1.29
Chandauli	1.07	1.46	0.95	1.25	1.16	1.56
Bhabhua	0.75	1.21	0.65	1.01	0.85	1.32
Gaya	0.49	1.18	0.39	1.04	0.66	1.32
Hazaribagh	0.80	1.11	0.64	0.93	1.15	1.31
Uttar Pradesh	1.02	1.31	0.86	1.07	1.11	1.45
Bihar and Jharkhand	0.64	1.18	0.52	1.01	0.80	1.32
Total	0.86	1.25	0.68	1.04	1.01	1.40

Figure 10(a): Per capita weekly trip rate (aggregate)

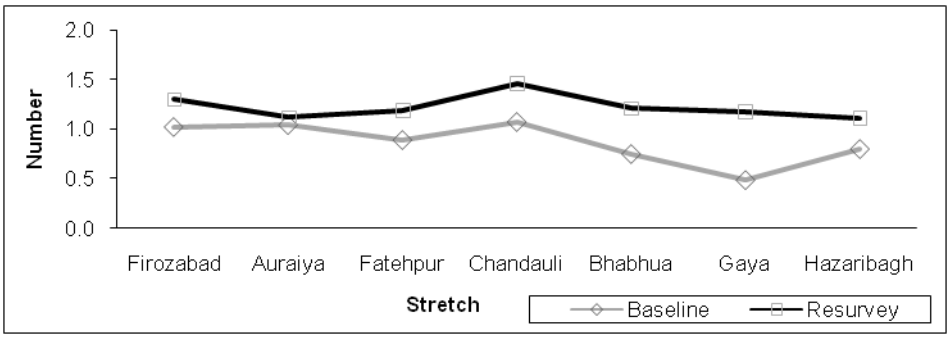


Figure 10(b): Per capita weekly trip rate among the poor

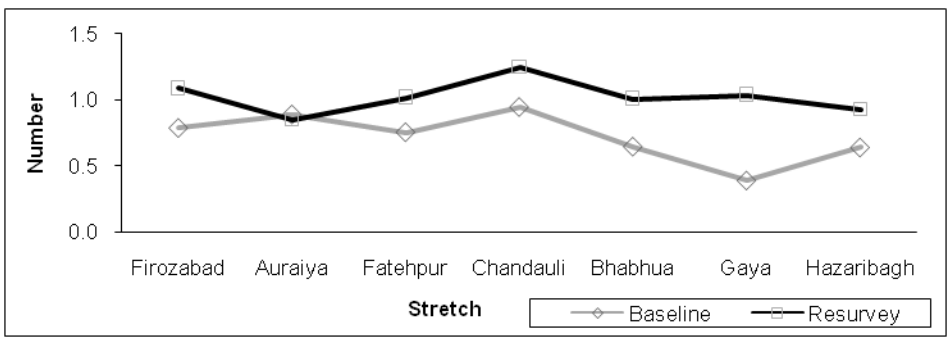
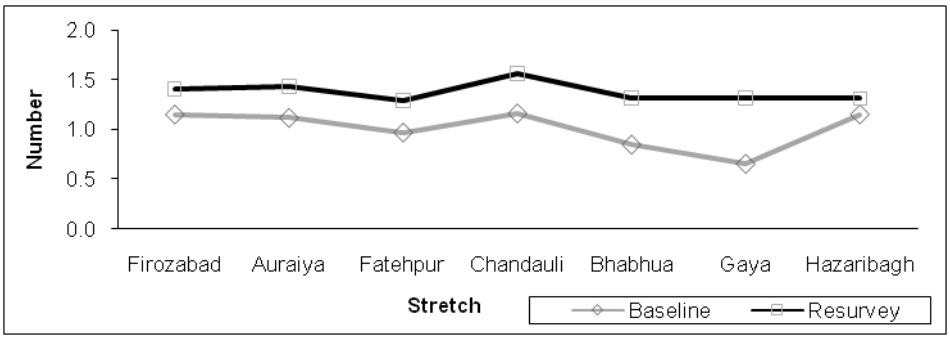


Figure 10(c): Per capita weekly trip rate among the non-poor



Per capita weekly trip length

Improvement in access and availability of transportation services determines the length of a trip undertaken by an individual. Spatial extension, in turn, leads to improvement in the availability of economic opportunities. The average per capita weekly trip length has increased across all the stretches both for the poor and non-poor households. It is observed that though per capita trip length is higher among the non-poor compared to the poor in Bihar and Jharkhand, the growth rate registered has been higher for the poor.

Table 10(b): Travel characteristics – Per capita weekly trip length (km)

Stretch	Aggregate		Poor		Non-poor	
	Baseline	Resurvey	Baseline	Resurvey	Baseline	Resurvey
Firozabad	8.97	18.45	8.54	12.52	9.20	21.43
Auraiya	6.07	14.63	4.89	9.29	6.68	20.58
Fatehpur	6.45	14.57	4.81	9.71	7.43	17.35
Chandauli	9.54	17.16	6.75	10.22	11.35	20.24
Bhabhua	6.49	12.43	4.59	7.11	8.35	15.67
Gaya	3.90	10.32	2.59	9.96	5.96	10.68
Hazaribagh	7.41	11.64	3.61	7.56	15.38	16.00
Uttar Pradesh	8.27	16.64	6.59	10.52	9.25	20.10
Bihar and Jharkhand	5.43	11.30	3.40	8.66	8.23	13.53
Total	7.09	14.39	4.91	9.62	8.92	17.58

Figure 10(d): Per capita weekly trip length (aggregate)

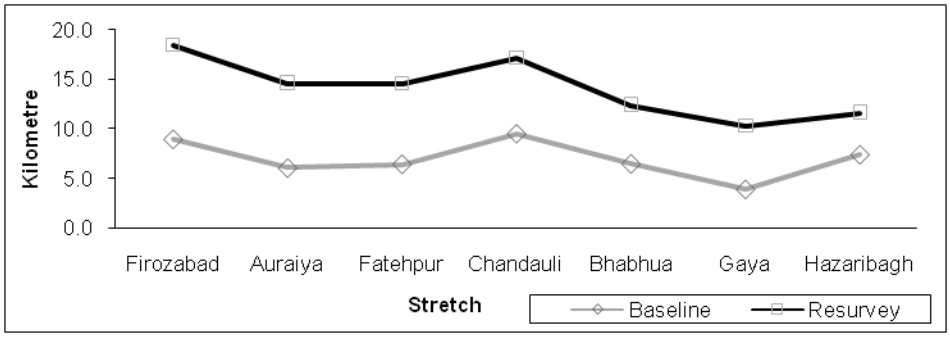


Figure 10(e): Per capita weekly trip length among the poor

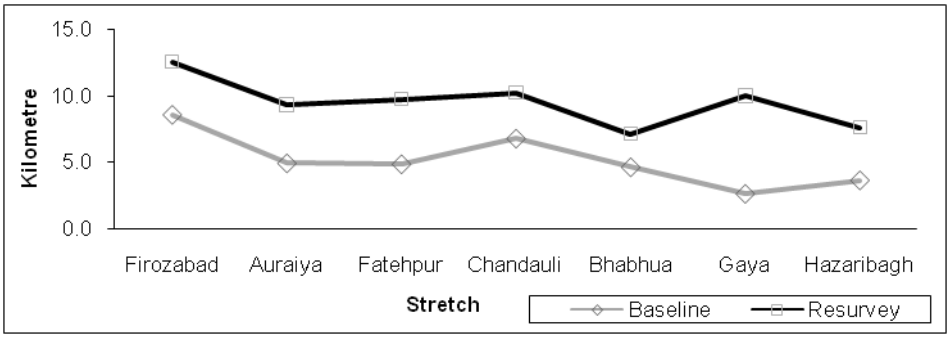
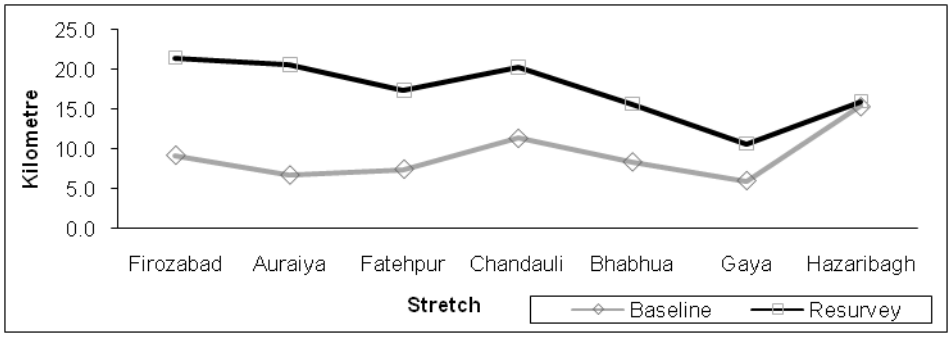


Figure 10(f): Per capita weekly trip length among the non-poor



Poverty ratio

Poverty in India has eluded all definitions and the government is making yet one more attempt by setting up committees to know who really its poor people are. High incidence of poverty was an important criterion for selecting the stretches in this study. The results show that on the basis of monthly per capita expenditure, the incidence of poverty on headcount basis has declined in all the stretches except Auraiya in Uttar Pradesh. Despite this welcome trend, the percentage of the poor is still higher in Bihar and Jharkhand compared to Uttar Pradesh.

Table 11: Distribution of households according to the poverty ratio based on monthly per capita expenditure (MPCE)

Stretch	Percentage of poor households		Percentage of poor family members	
	Baseline	Resurvey	Baseline	Resurvey
Firozabad	31.96	32.27	34.54	33.39
Auraiya	30.36	44.23	34.31	52.72
Fatehpur	35.50	33.16	37.53	36.43
Chandauli	40.41	29.45	39.35	30.77
Bhabhua	52.88	37.04	49.35	37.82
Gaya	59.29	46.53	61.08	49.61
Hazaribagh	65.87	47.52	67.70	51.71
Uttar Pradesh	**35.33**	**33.42**	**36.87**	**36.09**
Bihar and Jharkhand	**58.22**	**43.45**	**58.04**	**45.71**
Total	**44.03**	**37.28**	**45.65**	**40.15**

Figure 11(a): Percentage of poor households (total)

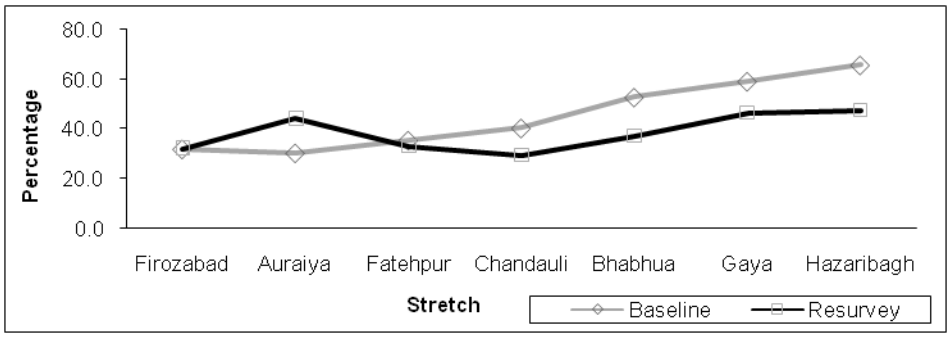
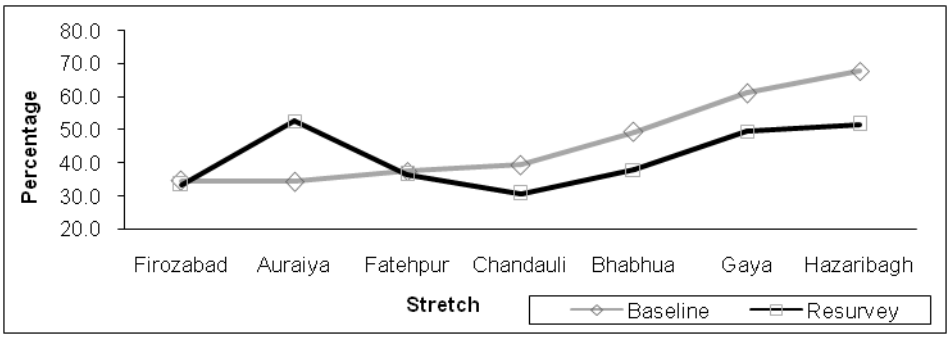


Figure 11(b): Percentage of poor family members – headcount ratio (total)



Poverty ratio for scheduled caste and scheduled tribe (SC/ST) households

While assessing the impact of upgradation of NH2 on the overall household as well as headcount poverty ratio, we have further looked into how the impact has varied from one social class to another like scheduled castes/ scheduled tribes (SC/ST) and non-SC/ST. This would help us to understand how socially inclusive has been the upgradation of NH2.

Scheduled castes and scheduled tribes constitute around 25 percent of the national population. The incidence of poverty is invariably high for this deprived section of the society. This has been corroborated by the results of the present study also: 52.7 percent as against 37.2 percent at the aggregate level. While overall poverty has declined, this section has actually seen increase in the proportion of poor households in both Auraiya and Firozabad. However, the temporal change has been somewhat better in the case of Bihar and Jharkhand. Uttar Pradesh has not fared well.

Table 12: Proportion of poor households among the scheduled castes and scheduled tribes

Stretch	Percentage of poor households		Percentage of poor family members	
	Baseline	Resurvey	Baseline	Resurvey
Firozabad	39.90	48.48	43.33	49.69
Auraiya	38.41	54.61	42.91	64.34
Fatehpur	51.70	48.08	55.91	53.43
Chandauli	52.38	42.18	54.92	46.04
Bhabhua	69.40	54.32	68.79	56.78
Gaya	67.05	64.71	71.48	69.14
Hazaribagh	68.52	56.14	67.76	61.98
Uttar Pradesh	46.16	47.73	49.77	52.25
Bihar and Jharkhand	68.06	60.13	70.01	63.91
Total	54.89	52.71	58.09	57.14

Figure 12(a): Percentage of poor households among scheduled caste and scheduled tribes

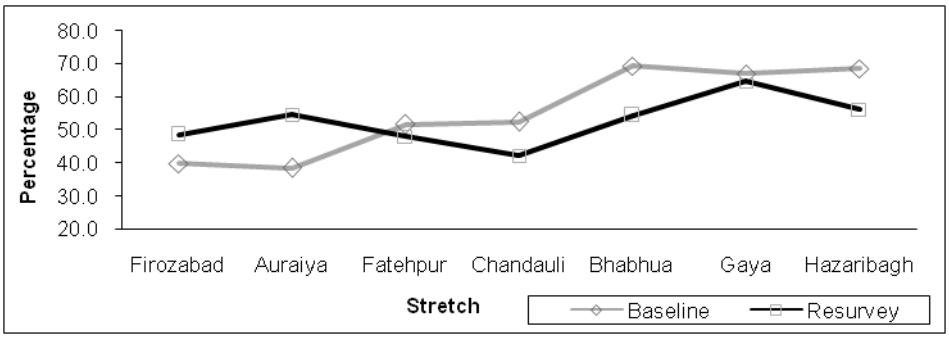
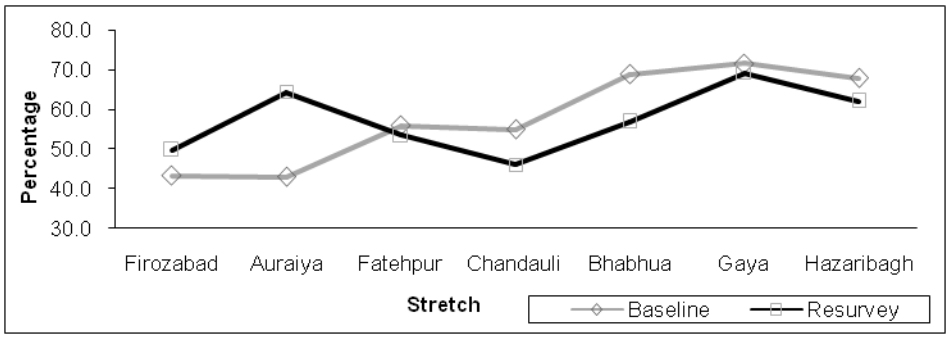


Figure 12(b): Percentage of poor family members – headcount ratio among scheduled caste and scheduled tribes



Average land holding per household

The average land holding per household is as low as 0.63 ha. It is marginally higher in Bihar and Jharkhand than in Uttar Pradesh. The poor have abysmally low levels of land holding of only 0.21 ha. Average land holding has declined in Bihar and Jharkhand, while it has increased in Uttar Pradesh for the poor households. The non-poor households are better off in Bihar and Jharkhand with an average land holding of

0.98 ha as compared to 0.81 ha in Uttar Pradesh. The comparison implies disparity in resource endowments, pronounced in the states of Bihar and Jharkhand[3]. The data also shows that the average size of land holding is much below the size of economic holding required to sustain a family of five members, estimated at 1.29 ha with fairly high value productivity of land[4].

Ownership of consumer durables

Ownership of consumer durables is a well-being indicator of a household. This number has almost doubled since the baseline survey period across all the stretches and, importantly, both for the poor and non-poor households. However, in spite of this welcome development, the non-poor are much better endowed than the poor. It may be mentioned that the ownership of consumer durables has increased more across all the income classes in Bihar and Jharkhand compared to Uttar Pradesh.

Share of income from agriculture

Share of income from agriculture has no doubt increased, but the number of households engaged in agricultural activities has gone down. The former is due to increase in income from cultivation, while the latter indicates shift to non-agricultural activities. The data shows that the poor households have a smaller share of income from agriculture in comparison to the non-poor households. This further confirms noticeable increase in the participation of the poor in non-agricultural activities. There has been significant increase in the share of income from agriculture in Bihar and Jharkhand across all the income classes compared to Uttar Pradesh.

Table 13(a): Asset ownership among households (aggregate)

Stretch	Average landholding per household		Average number of consumer durables owned per household		Share of income from agriculture (%)	
	Baseline	Resurvey	Baseline	Resurvey	Baseline	Resurvey
Firozabad	0.63	0.57	1.86	3.99	56.84	51.65
Auraiya	0.56	0.54	1.26	2.92	44.41	32.87
Fatehpur	0.26	0.57	1.41	2.44	46.71	46.18
Chandauli	0.66	0.67	2.72	4.64	43.71	48.61
Bhabhua	1.03	0.97	2.40	4.98	40.09	47.97
Gaya	0.37	0.44	1.20	3.51	27.79	29.49
Hazaribagh	0.59	0.66	1.34	3.71	13.81	19.98
Uttar Pradesh	0.55	0.60	1.97	3.75	47.80	46.92
Bihar and Jharkhand	0.63	0.66	1.63	4.04	30.32	36.70
Total	0.58	0.62	1.84	3.86	42.65	43.49

3. A recent study by Tsujita, et al. (2010) finds that the intra state disparities have actually increased in Bihar and are largely dependent on resource endowments.
4. Bhalla, G. S. and Singh Gurmail (2001), 'Indian Agriculture: Four Decades of Development'. Sage Publications.

Figure 13(a): Average land holding per household (ha) – aggregate

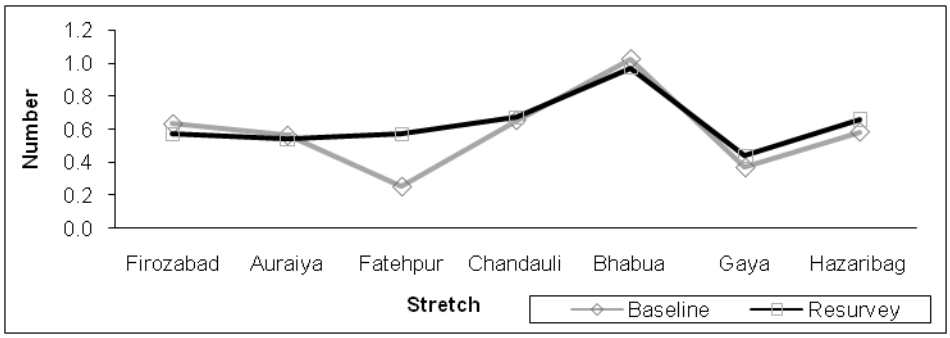


Figure 13(b): Average number of consumer durables owned per household – aggregate

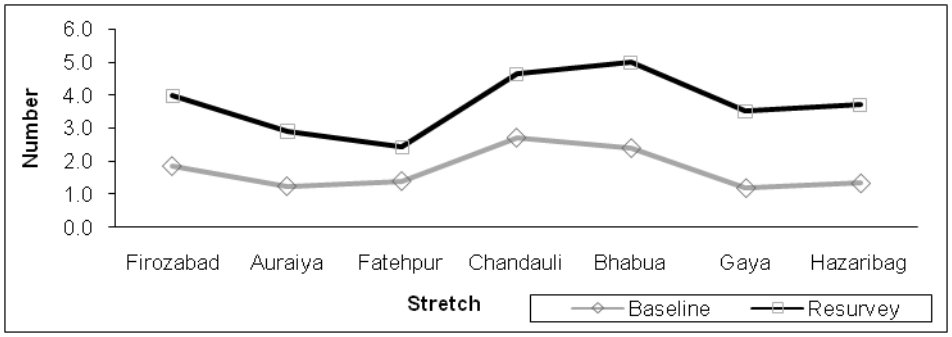


Figure 13(c): Share of income from agriculture – aggregate

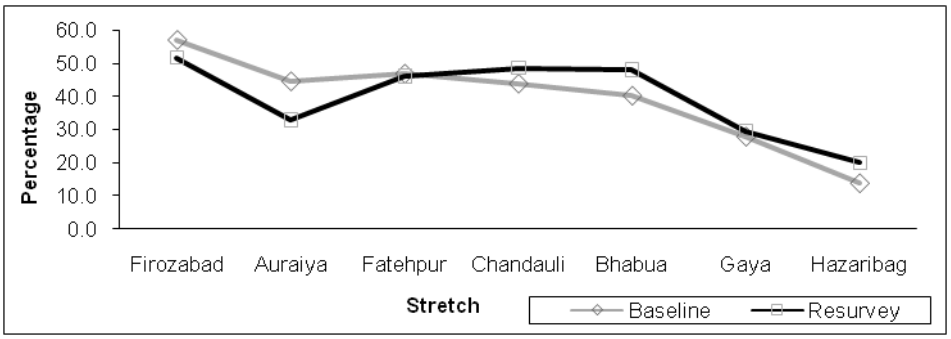


Table 13(b): Asset ownership among the poor households

Stretch	Average landholding per household		Average number of consumer durables owned per household		Share of income from agriculture (%)	
	Baseline	Resurvey	Baseline	Resurvey	Baseline	Resurvey
Firozabad	0.23	0.18	1.22	2.20	44.75	25.56
Auraiya	0.22	0.30	0.62	1.98	33.14	31.32
Fatehpur	0.06	0.17	0.46	1.52	28.55	20.89
Chandauli	0.17	0.14	1.31	2.16	26.04	31.65
Bhabhua	0.20	0.07	0.88	2.50	25.15	18.11
Gaya	0.26	0.21	0.79	2.34	24.32	18.49
Hazaribagh	0.43	0.60	0.87	2.85	13.16	15.44
Uttar Pradesh	0.17	0.19	1.02	2.01	32.43	27.94
Bihar and Jharkhand	0.27	0.24	0.84	2.48	0.23	17.78
Total	0.22	0.21	0.93	2.23	27.86	23.67

Figure 13(d): Average land holding per household (ha) among the poor

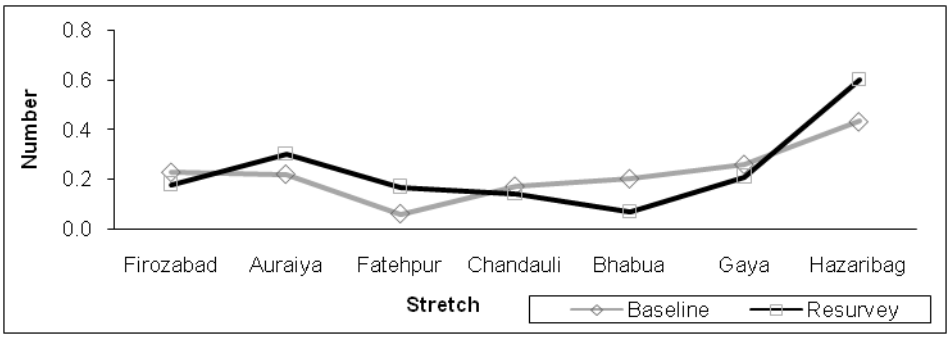


Figure 13(e): Average number of consumer durables owned per household among the poor

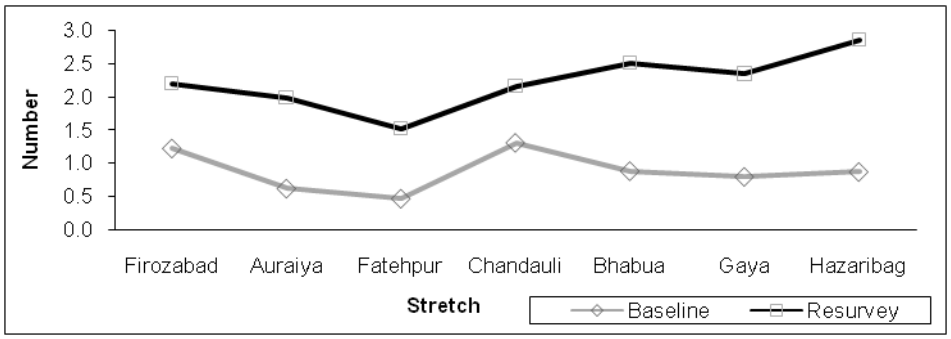


Figure 13(f): Share of income from agriculture among the poor

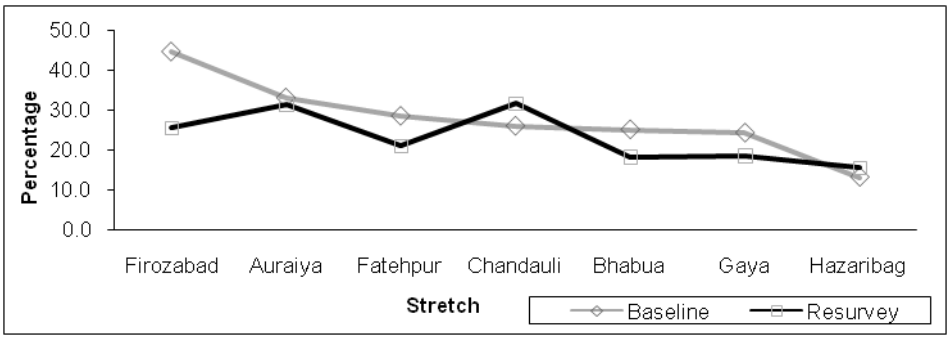


Table 13(c): Asset ownership among the non-poor households

Stretch	Average landholding per household		Av no of consumer durables owned per household		Share of income from agriculture (%)	
	Baseline	Resurvey	Baseline	Resurvey	Baseline	Resurvey
Firozabad	0.63	0.76	1.86	4.80	56.84	57.12
Auraiya	0.56	0.74	1.26	3.63	44.41	33.62
Fatehpur	0.26	0.78	1.41	2.88	46.71	50.71
Chandauli	0.66	0.88	2.72	5.66	43.71	51.17
Bhabhua	1.03	1.5	2.40	6.44	40.09	53.79
Gaya	0.37	0.63	1.20	4.54	27.79	34.37
Hazaribagh	0.59	0.71	1.34	4.51	13.81	22.45
Uttar Pradesh	0.55	0.81	1.97	4.58	47.80	50.86
Bihar and Jharkhand	0.63	0.98	1.63	5.25	0.32	42.91
Total	0.58	0.87	1.84	4.81	42.65	48.35

Figure 13(g): Average land holding per household (ha) among the non-poor

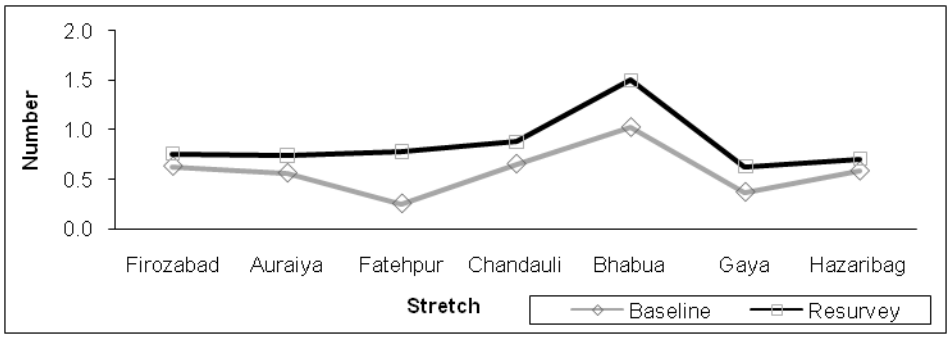


Figure 13(h): Average number of consumer durables owned per household among the non-poor

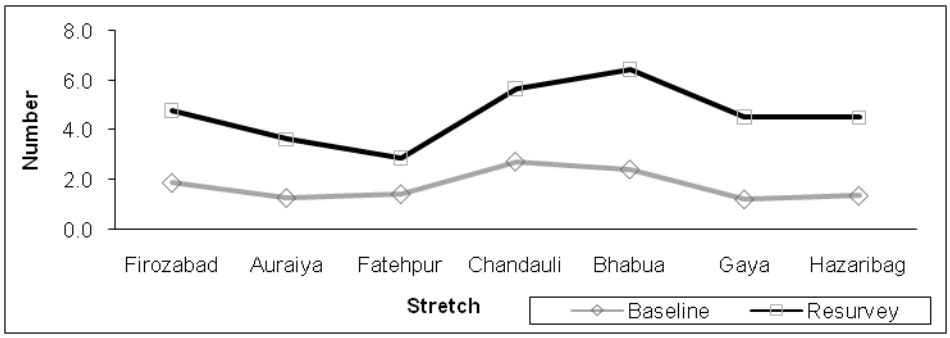
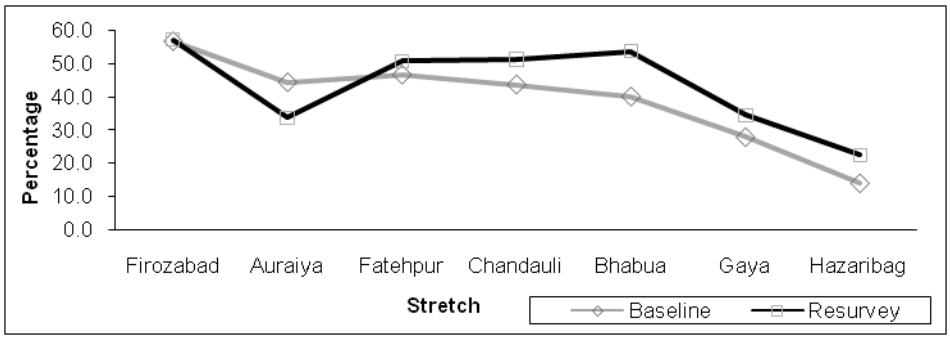


Figure 13(i): Share of income from agriculture among the non-poor



Proportion of working population

The share of working population has registered an increase of 4 percentage points, across most of the stretches. The increase has been slightly higher among the non-poor compared to the poor. At the state level, Bihar and Jharkhand have shown much more increase in the working population than Uttar Pradesh, for both the poor and non-poor households.

Table 14: Proportion of working population (percent)

Stretch	Aggregate		Poor		Non-poor	
	Baseline	Resurvey	Baseline	Resurvey	Baseline	Resurvey
Firozabad	28.00	32.54	25.06	30.53	29.55	33.55
Auraiya	30.68	33.61	27.44	31.00	32.37	36.51
Fatehpur	31.39	36.26	29.45	34.37	32.56	37.34
Chandauli	29.10	33.54	29.75	31.64	28.68	34.39
Bhabhua	26.90	32.42	26.88	33.31	26.92	31.89
Gaya	29.96	36.65	29.32	35.94	30.98	37.35
Hazaribagh	28.71	31.27	28.34	28.61	29.49	34.12
Uttar Pradesh	29.45	33.77	28.11	31.71	30.24	34.94
Bihar and Jharkhand	28.66	34.23	28.39	33.77	29.03	34.62
Total	29.12	33.97	28.26	32.70	29.85	34.81

Figure 14(a): Proportion of working population (aggregate)

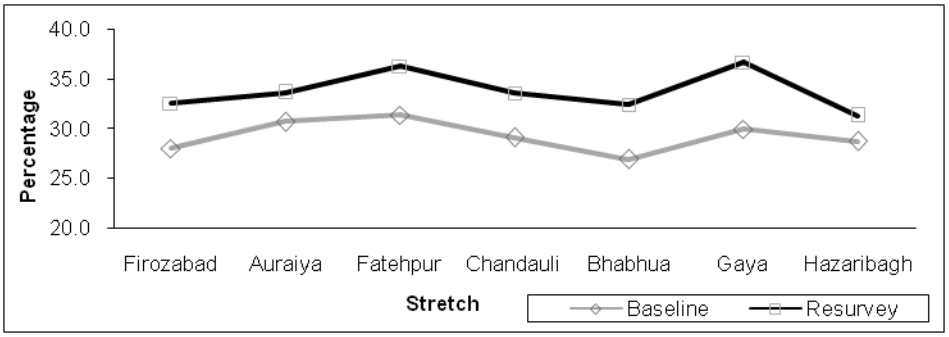


Figure 14(b): Proportion of working population among the poor

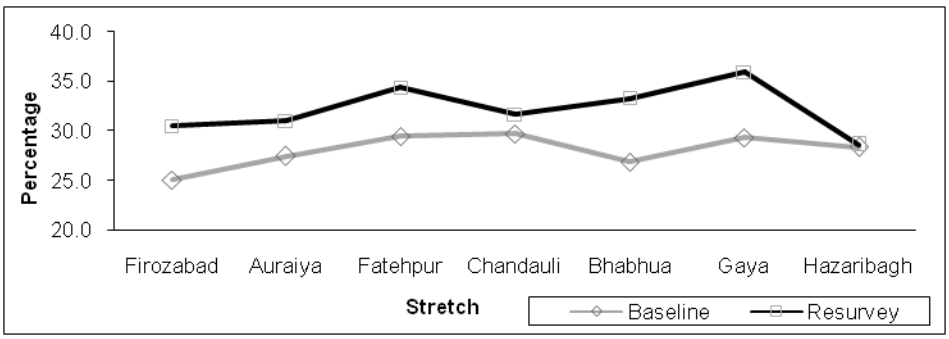
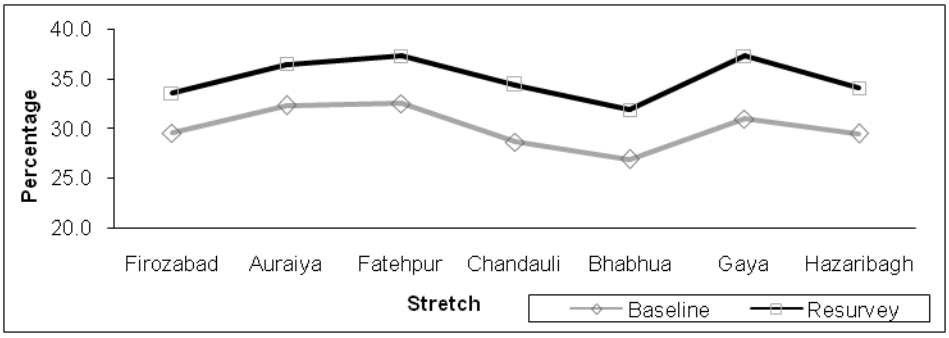


Figure 14(c): Proportion of working population among the non-poor



Proportion of working population among females

The participation of women in the workforce contributes to both social awareness and well-being. In the present study, the proportion of working women in the total female population has registered manifold increase, across all selected stretches and economic classes, with Bihar and Jharkhand registering more increase compared to Uttar Pradesh. Generally, the female workforce participation rates are higher in the poor households and this was the position at the time of the baseline survey. In the interregnum, this has undergone a dramatic change: the percentage rates of working women both for the poor and non-poor households have leveled off.

Table 15: Proportion of working women in the female population (percent)

Stretch	Aggregate		Poor		Non-poor	
	Baseline	Resurvey	Baseline	Resurvey	Baseline	Resurvey
Firozabad	2.47	8.93	1.69	7.25	2.90	9.78
Auraiya	3.14	11.04	1.77	9.76	3.84	12.44
Fatehpur	6.30	15.57	8.15	14.81	5.11	16.01
Chandauli	7.47	14.55	10.36	13.83	5.56	14.87
Bhabhua	3.49	14.40	4.36	18.35	2.63	11.99
Gaya	6.85	20.36	7.47	19.19	5.88	21.57
Hazaribagh	5.02	8.72	4.53	6.84	6.01	10.88
Uttar Pradesh	5.21	12.61	6.48	11.38	4.44	13.31
Bihar and Jharkhand	5.33	16.25	5.93	16.57	4.51	15.97
Total	5.26	14.18	6.19	13.94	4.46	14.35

Figure 15(a): Proportion of working women in the female population (aggregate)

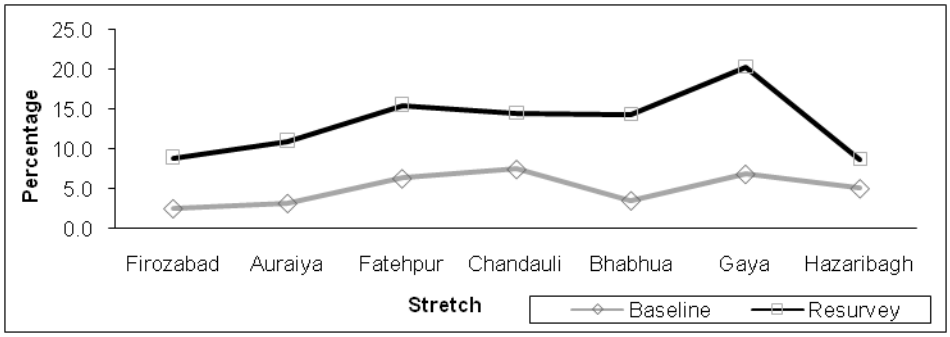


Figure 15(b): Proportion of working women in the female population among the poor

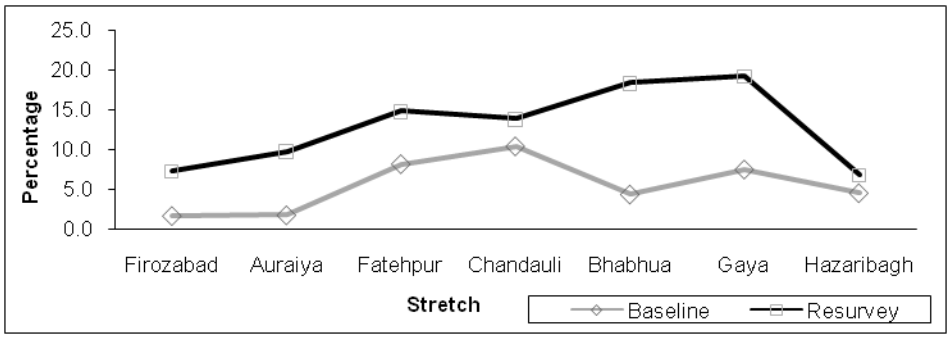
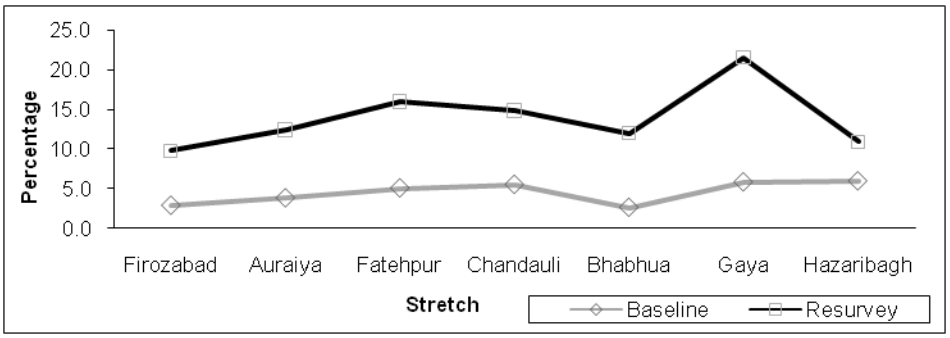


Figure 15(c): Proportion of working women in the female population among the non-poor



Proportion of working population in non-agricultural activities

The poor tend to earn a significant share of total income from casual non-farm wage employment and hence this is considered to be helpful in lowering rural poverty. According to the NCAER data, non-farm income in rural India contributed, on average, about one-third (34 per cent) of total household income in 1993-94.[5] In the present study, it has been observed that the share of the working population in non-agricultural activities has increased in the resurvey[6]. This increment is higher for Uttar Pradesh compared to Bihar and Jharkhand. Poor people are more engaged in non-agricultural activities compared to the non-poor as seen both in the baseline survey and resurvey. This implies that non-agricultural job opportunities for poor people have increased over the years.

Table 16: Proportion of working population in non-agricultural activities (percent)

Stretch	Aggregate		Poor		Non-poor	
	Baseline	Resurvey	Baseline	Resurvey	Baseline	Resurvey
Firozabad	46.79	59.95	50.34	74.37	45.21	53.37
Auraiya	36.51	59.30	44.25	63.01	33.08	55.79
Fatehpur	42.03	57.16	50.21	64.46	37.58	53.31
Chandauli	62.45	59.24	72.00	68.51	56.03	55.45
Bhabhua	57.95	57.51	65.75	66.50	50.36	51.80
Gaya	56.84	61.08	57.68	67.81	55.60	54.71
Hazaribagh	64.66	76.34	65.83	79.09	62.32	73.88
Uttar Pradesh	50.01	59.03	58.66	67.93	45.32	54.47
Bihar and Jharkhand	58.56	62.18	61.62	69.23	54.41	56.40
Total	53.50	60.37	60.23	68.57	48.16	55.20

5. Lanjouw P, Shariff A. (2004): 'Rural Non-Farm Employment in India: Access, Incomes and Poverty Impact' Economic and Political Weekly, 2004, October.
6. A recent survey by labour bureau shows that the share of non-agricultural sector in total employment stands around 55 percent. These numbers along with the current study numbers highlight the overall changes taking place in the economy as more jobs are created in non agricultural sector. This means that as less and less number of people earn their livelihood from agriculture, the income of those dependent on agriculture is also likely to go up. Government of India, 2010. "Report on Employment and Unemployment Survey (2009-10). " Ministry of Labour & Employment, New Delhi.

Figure 16(a): Proportion of working population in non-agricultural activities (aggregate)

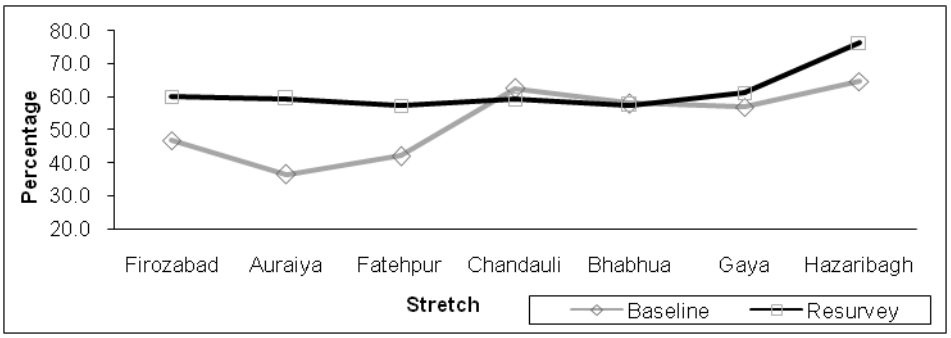


Figure 16(b): Proportion of working population in non-agricultural activities among the poor

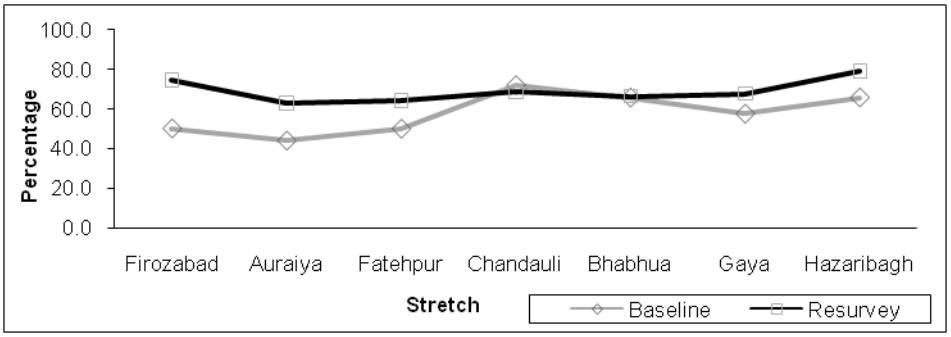
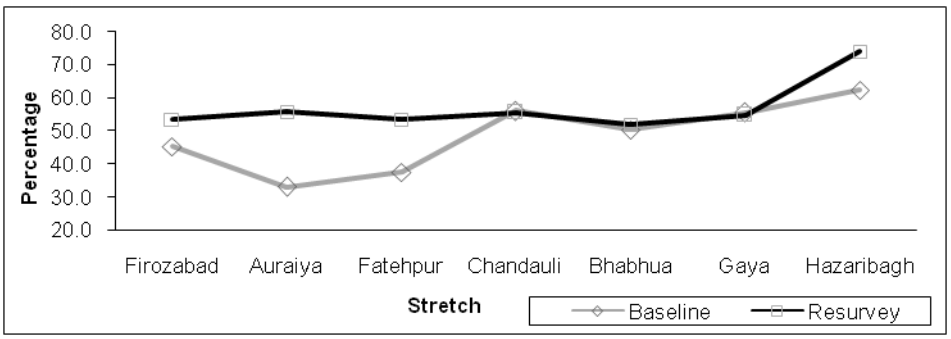


Figure 16(c): Proportion of working population in non-agricultural activities among the non-poor



Concluding observations

The rural economy has witnessed a distinct structural shift in terms of an increase in non-farm activities, higher workforce participation, an increase in school enrolment and better literacy levels. Female participation in workforce has risen as also the school enrolment of girls. This, in turn, has helped empower women, a development of considerable importance for the country.

Mobility levels have also increased across all the income classes in terms of increases in per capita weekly trip rates as well as trip lengths. This is a clear indication of improvement in job opportunities and access to markets, schools, and

other services. This is also a sign of increase in the spatial distribution of economic activities.

Economic growth and development have been widespread and largely inclusive. However, the effects of such development have not been uniform across time or across economic classes. Although the differences have remained they have substantially narrowed. With Bihar and Jharkhand showing greater improvement, the disparities have considerably reduced.

The non-poor or not-so-poor have benefitted more than the poorer ones. This is perhaps typical of the early days of development as better-off persons have better access to facilities. As time goes by, it can be expected that benefits would become more even.

Human dignity depends to a great extent on education. Labour productivity in the long run is also a function of the levels of schooling received. Average school enrolment among children has increased to more than 90 percent. Significantly, the enrolment level among the poor households has also been high – 86 percent. Furthermore, Bihar and Jharkhand have shown considerable improvement in this regard. All these developments have long-term beneficial implications.

The overall literacy level has improved across all the stretches, but it is still somewhat lower than the national average. The interstate and class differences also persist. For example, for the poor households, literacy is 17 percent less compared to the non-poor households. However, the female literacy rate among the poor households has increased at a much faster rate than the non-poor households.

It is now well-established that the individual and social returns from the women's education are exceptionally high, especially in the matter of lowering of fertility and infant and child mortality rates, and improvement in the children's educational achievements. There has been a significant rise in school enrolment among girls even in the poor households. In this respect, both Bihar and Jharkhand have done well.

The proportion of working women in the total female population has registered a manifold increase across all economic classes, with Bihar and Jharkhand

registering higher increase. Generally, the female workforce participation rates are higher in the poor households. This position has undergone a dramatic change. The women from not-so-poor households are also equally participating in the workforce.

The overall sex ratio (number of females per 1000 males) has remained unchanged and continues to be lower than the national average. The poor households have a higher sex ratio than the non-poor households. Arguably, better-off communities have a stronger gender bias against the female than poor households.

In terms of poverty indicators, the proportion of people living below the poverty line has declined significantly for all the stretches except Auraiya in Uttar Pradesh both on an overall basis and headcount basis. For scheduled castes and scheduled tribes, this proportion has also reduced for all the stretches except at two places in Uttar Pradesh, viz., Auraiya and Firozabad, both on an overall basis and headcount basis.

The average landholding per household is low at 0.63 hectare, with marginally higher holdings in Bihar and Jharkhand. There is pronounced disparity in resource endowments across the economic classes. The average landholding of a poor household is abysmally low – one-eighth of a hectare in Uttar Pradesh and a quarter of a hectare in Bihar and Jharkhand. The non-poor households are better off, particularly in Bihar and Jharkhand with an average landholding of 0.98 hectare.

The share of income from agriculture particularly in Bihar and Jharkhand has increased but the number of households engaged in agricultural activities has gone down in all the representative stretches. The poor households have a smaller share of income from agriculture in comparison to the non-poor households. However, in case of poor households, their share from non-agricultural activities has increased.

Chapter 4

Impact Evaluation at Village Level

As mentioned elsewhere in the report, the socio-economic impact analysis of a public investment project (like the present one of 4-laning of NH2) is made to determine the extent of the net socio-economic benefits of the project that accrue to the population group(s) concerned, with a focus on poverty alleviation. Typically, such analysis comprises two studies of the socio-economic conditions of these group(s) – one, based on baseline survey data (collected before the project is launched) and the other, based on the resurvey data (collected after the project has been completed). The partial effects of the project are then assessed by appropriately comparing and interpreting the results of these two studies. This report presents the results of a study of the impact analysis of widening of the NH2 based on the comparison of the socio-economic conditions of the population living around the stretch of NH2 being widened, before and after the project.

The rationale of the present study is based on the premise that, *ceteris paribus*, access to a highway provides to the population living in its appropriately defined neighbourhood opportunities that help improve their well-being. To verify this presumption empirically, the relationship between the selected village-level indicators of socio-economic well-being and the proximity of villages to NH2 has been examined. This relationship is further influenced by the quality and width of the highway and is therefore indicative of the positive impact of highway widening. Three different statistical/econometric techniques, viz., correlation analysis, non-parametric regression analysis, and comparison of means have been used to analyse the baseline and the resurvey data collected. The results of these analyses are presented in the following sections.

Village level variables

For the present analysis, 16 village-level socio-economic variables that are likely to be influenced directly or indirectly by the proximity of the villages to NH2 have been considered (Table 1). These variables may be categorised into seven groups. Of these, five groups, viz., incidence of poverty, transport infrastructure, employment, asset ownership, and education and other infrastructure, relate to the well-being of the population. Another group relates to the demographic characteristics which reflect the role of better economic opportunities arising from proximity to

NH2. The last group of variables relating to land prices indicates an important indirect economic effect due to a rent element generated by NH2 and its 4-laning. All these variables alternatively reflect the level of economic development of a village.

Table 1: List of variables used to study impact of proximity to NH2 based on the village-level data

Variables	
Demographic **V1** Population density (population per sq km) **Incidence of poverty** **V2** Proportion of BPL households **Transport infrastructure** **V3** Share of motorised vehicles in total transport vehicles **Employment** **V4** Proportion of non-agricultural workers in total main workers **Asset ownership** **V5** Number of milch animals per household **V6** Proportion of semi-pucca and pucca houses	**Education and other infrastructure** **V7** Number of teachers per school **V8** Number of enrolled students per school **V9** Number of girl students enrolled per school **V10** Proportion of literate population above 6 years of age **V11** Whether a village has banking facilities **V12** Whether a village has cooperative society **Price of land and dairy products** **V13** Price of irrigated crop land (Rs./acre) **V14** Price of unirrigated crop land (Rs./acre) **V15** Price of residential land (Rs./acre) **V16** Sale price of milk (Rs./litre)

Summary statistics

Table 2 gives the summary statistics showing the number of observations, their mean values and coefficient of variation for both the baseline and resurvey period. The variation in the number of observations is due to the fact that some of the variables could not be observed due to their non-existence in the case of certain sample villages. The coefficient of variation shows relative dispersion of the variables as reflected by the sample value.

The resurvey data reflects an overall economic betterment of the people. The proportion of households living below the poverty line has declined. This is also accompanied by an improvement in some of the human development indicators. Access to education has become easier, so also the availability of other infrastructural facilities like transport infrastructure, banking facilities, etc. An important finding is the change in the employment pattern with more jobs created in the non-agricultural sector. The asset ownership, however, shows a decline as indicated by fall in the mean value of both the indicators. This when seen in conjunction with increase in population density and decline in poverty level may indicate that the benefit of development has not been distributed equitably.

Table 2: Summary of selected demographic and socio-economic impact indicators at village level

Variable	Baseline			Resurvey		
	Number of obser-vations	Mean value	Coefficient of variation (percent)	Number of obser-vations	Mean value	Coefficient of variation (percent)
V0 Approach distance from NH2 (in km)	200	4.34	79.26	200	4.34	79.26
Demographic						
V1 Population density	200	564.34	59.72	200	723.13	132.45
Incidence of poverty						
V2 Proportion of BPL households	200	38.23	62.43	200	34.70	85.21
Transport infrastructure						
V3 Share of motorised vehicles in total transport vehicles	200	8.56	80.16	200	16.00	76.76
Employment						
V4 Proportion of non-agricultural workers in total main workers	200	19.56	127.73	199	35.65	78.16
Asset ownership						
V5 Number of milch animals per household	200	1.87	67.98	200	1.12	123.30
V6 Proportion of semi-pucca and pucca houses	200	60.31	60.25	200	54.80	54.19
Education and other infrastructure						
V7 Number of teachers per school	151	3.28	60.8	167	4.16	49.86
V8 Number of enrolled students per school	151	55.43	118.3	167	133.12	70.72
V9 Number of girl students enrolled per school	151	23.14	105.84	167	59.39	73.32
V10 Proportion of literate population above 6 years of age	200	43.27	44.27	200	59.35	28.76
V11 Whether a village has banking facilities	200	12	36.83	200	138.00	67.20
V12 Whether a village has cooperative society	200	19.5	203.69	200	83.00	119.03
Price of land and dairy products						
V13 Price of irrigated crop land (Rs./acre)	200.00	186,243.75	63.09	200	826,105.56	194.42
V14 Price of unirrigated crop land (Rs./acre)	187.00	117,940.00	85.58	186	191,494.74	79.95
V15 Price of residential land (Rs./acre)	200.00	427,005.00	114.99	200	2,734,254.64	377.66
V16 Sale price of milk (Rs./litre)	200.00	10.46	22.47	200	13.87	16.83

Note: The demographic data is based on Census of India, 1991, 2001 has been extrapolated for the relevant survey years

Correlation analysis

For a preliminary analysis, the pattern of interdependence among various chosen variables has been examined using the simple correlation coefficient between pairs of variables. As is well known, the correlation coefficient is an index of the degree of linear dependence of a pair of variables as present in a given data set. The computed correlation matrix is presented in Table 3.

Table 3: Correlation among selected socio-economic indicators at village level

	V0	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16
V0	1																
V1	-0.1787*	1															
V2	-0.119	-0.1316	1														
V3	-0.0667	0.0335	0.0051	1													
V4	-0.2235*	0.2041	0.0219	0.0386	1												
V5	0.0856	-0.1953	0.1352	0.144	-0.0494	1											
V6	-0.1724*	0.0772	-0.2245	0.148	0.2057	0.0156	1										
V7	-0.1127	0.1525	0.0424	0.0808	0.1479	-0.0033	0.0841	1									
V8	-0.0711	0.0788	0.0858	0.0431	0.0584	0.0002	-0.3432	0.2245	1								
V9	-0.0537	0.0674	0.0278	0.056	0.0323	-0.0544	-0.3092	0.1961	0.9497	1							
V10	0.0412	-0.0526	-0.1826	0.1183	0.298	0.0133	0.5512	0.1415	-0.1708	-0.1428	1						
V11	0.0368	0.0136	-0.0364	0.0642	0.0562	0.109	0.1936	0.0676	0.0492	0.0382	0.1707	1					
V12	0.0011	-0.0205	0.0949	-0.1353	-0.0257	-0.0824	-0.2121	0.1234	0.2271	0.2357	-0.249	-0.1595	1				
V13	-0.0827	0.1211	0.121	-0.0103	0.2355	-0.0514	-0.1005	0.0617	0.1843	0.1778	-0.0017	0.1159	-0.0317	1			
V14	0.0351	0.2018	0.0502	0.0284	0.1254	-0.1092	-0.0406	0.2289	0.2189	0.1925	-0.001	-0.0331	0.0789	0.1201	1		
V15	-0.1328	0.0506	0.0142	-0.0453	0.1941	-0.0541	-0.0791	0.0829	0.1162	0.0927	-0.082	0.0369	0.1164	0.1114	0.2179	1	
V16	0.1057	-0.065	0.0657	0.0104	-0.2038	0.0649	-0.2925	0.0881	0.2747	0.2717	-0.2733	-0.062	0.1641	-0.0158	0.0233	-0.0222	1

*Note: * are significant at 5 percent level with the distance from NH2 V0: denotes approach distance of the village from NH2 (km)*

As the above results suggest, the degree of pair-wise association with V0 (i.e. distance from NH2) is significant with the expected sign for three of the chosen well-being indicator variables – population density (V1), proportion of non-agricultural workers in total main workers (V4) and proportion of semi-pucca and pucca houses (V6). Importantly, these three correlations were also found to be statistically significant in the baseline analysis.

Table 3 also provides information on the degree of correlation between pairs of chosen 'well-being' indicators. It may be noted that, except in a few cases, such correlation is not strong. This suggests that, by and large, the chosen 'well-being' indicators reflect diverse aspects of well-being which are not closely related to one another.

The cases of strong correlation include the association between the proportion of semi-pucca and pucca houses and proportion of literate population above 6 years of age and between the number of enrolled students per school and the number of girl students enrolled per school. Significantly, these pairs of variables had also shown strong correlation in the baseline analysis. Importantly, this relationship has become stronger in the resurvey.

In sum, the correlation matrix suggests that there are higher job opportunities available for non-agricultural workers in closer proximity of the highway. This attribute also influences demographic characteristics in terms of density of population in nearby habitations. Better housing conditions are indicative of their economic well-being.

Comparison of means analysis

As a preliminary analysis, it has been examined whether the mean values of a variable for the influence and control zones are equal. This has been done by testing for each variable the null hypothesis that population means for two zones are the same[1]. The comparison of overall means for the two zones provides a benchmark of measurement of the differences in the average levels of various impact variables between the influence and control zones. Table 4 presents the mean values of the 16 selected village-level indicators of well-being for the two groups of villages in the influence and control zones. The table also provides the single difference between the

1. The significance of means has been tested using t-statistics.

two zones (i.e. the excess of the mean value of the influence zone over that of the control zone) in the base year and the resurvey year. While the single difference column represents the advantage of the influence zone over the control zone, the double difference column further shows the increase in this advantage between the two periods to be imputable to the upgradation or 4-laning of NH2. The asterisk sign (*) indicates the single differences being statistically significant at 5 percent level.

Table 4: Comparative mean values of selected village-level socio-economic indicators and their single difference and double difference between influence and control zone

Socio-economic indicator	Mean value		Baseline difference between influence zone and control zone (1) - (2)	Mean value		Resurvey difference between influence zone and control zone (4) - (5)	Double difference between influence zone and control zone (6)-(3)	Percentage increase of resurvey over the baseline
	Influence zone BL	Control zone BL		Influence zone Resurvey	Control zone Resurvey			
Demographic	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
V1 Population density	626.04	462.6	163.44*	820.44	562.72	257.72*	94.29	57.6909
Incidence of poverty								
V2 Proportion of BPL households	37.54	39.78	-2.24*	32.85	38.97	-6.12	-3.88	-173.2143
Transport infrastructure								
V3 Share of motorised vehicles in total transport vehicles	8.52	8.66	-0.14	17.01	14.10	2.91	3.06	-2185.71
Employment								
V4 Proportion of non-agricultural workers in total main workers	22.93	12.57	10.36*	39.95	25.43	14.52*	4.16	40.15444
Asset ownership								
V5 Number of milch animals per household	1.84	1.94	-0.1	0.98	1.48	-0.5	-0.40	-400
V6 Proportion of semi-pucca and pucca houses	63.46	53.29	10.17*	57.19	50.20	6.99	-3.18	-31.2684
Education and other infrastructure								
V7 Number of teachers per school	3.39	3.11	0.28	4.17	4.13	0.04	-0.23	-82.1429
V8 Number of enrolled students per school in the year 2002-03	51.55	61.53	-9.98	139.80	120.18	19.62	29.60	-296.593
V9 Number of girl students enrolled per school in the year 2002-03	21.86	25.15	-3.29	61.85	54.62	7.23	10.51	-319.453
V10 Proportion of literate population above 6 years of age	43.91	41.83	2.08*	59.24	59.63	-0.39	-2.48	-119.231
V11 Whether a village has banking facilities	15.15	5.88	9.27*	43.00	26.00	17*	7.73	83.38727
V12 Whether a village has cooperative society	21.97	14.71	7.26	28.50	13.00	15.5*	8.24	113.4986
Price of land and dairy products								
V13 Price of irrigated crop land (Rs./acre)	469655.3	344213.24	125442.1*	926977	630297	296680*	171237.50	136.5072
V14 Price of unirrigated crop land (Rs./acre)	118140.15	117551.47	588.68*	204057	209611	-5554	-6143.10	-1043.54
V15 Price of residential land (Rs./acre)	197178.03	165018.38	32159.65*	3391394	1458631	1932763	1900604.15	5909.903
V16 Sale price of milk (Rs./litre)*	10.73	5.12	5.61*	14	14	0	-5.78	-103.03

** Means of IZ and CZ are significantly different at a 5 percent level of significance. Using T statistics*

As would be seen from Table 4, the single difference in mean values between the influence zone and control zone is showing results as expected both in the baseline survey and resurvey for as many as 10 out of the 16 variables. This clearly validates

the 'basic neighbourhood premise' for studying the well-being of the population living in the proximity of the national highway.

In the resurvey, five variables – population density (V1), proportion of non-agricultural workers in total main workers (V4), availability of banking facilities (V11) availability of cooperative society (V12) and price of irrigated crop land (V13) – have shown not only significant differences in mean values but their magnitude has also increased as compared to the baseline mean values.

Furthermore, irrespective of the significance, the percentage improvement in single differences of the resurvey over the baseline survey has also turned out to be positive for 50 percent of the variables, thereby reflecting positive impact of highway after its upgradation. These relate to population density (V1), proportion of BPL households (V2), proportion of non-agricultural workers in total main workers (V4), enrolment of students in schools (V8), enrolment of girl students in schools (V9), availability of banking facility (V11), availability of cooperative societies (V12) price of irrigated crop land (V13) and price of residential land (V15).

Non-parametric regression analysis

For a more rigorous examination of the extent and nature of the association of selected well-being indicators with approach distance of a village from the highway based on the available village-level data, we have used the bi-variate non-parametric regression analysis (Chapter 1 explains this econometric technique). To be more specific, for each of the sixteen well-being indicator variables, the graphs of the estimated non-parametric regression of the variable concerned on the distance from the highway have been obtained for both the baseline survey data and the resurvey data for the entire range of variation of the distance variable for the villages as covered by the said surveys. This range has been almost 8 km. These graphs are expected to show the gradient of change with a negative slope of a specific well-being indicator for which a higher value is better in relation to the distance from the highway.

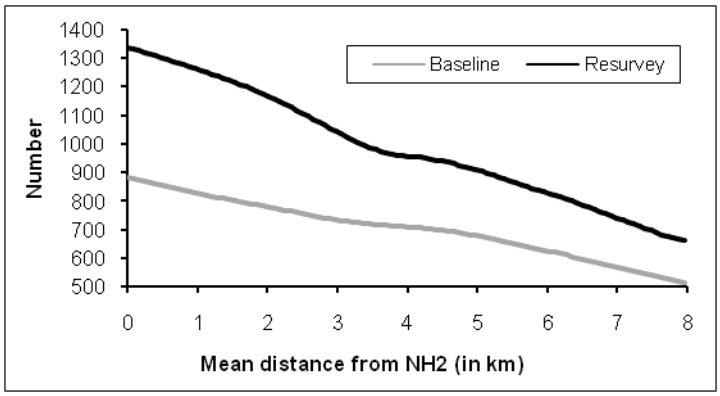
The results of the non-parametric regression analysis have brought out the well-behaved relationship with distance from the highway for most of the well-being indicator variables implicit in the village-level data set. In each of these cases, the estimated relationship is observed to be a monotonic one over either the entire range

of distance or up to a critical distance, which varies from one indicator to another. The graphs of the estimated non-parametric regression relationships are presented for both the surveys and explained in the following section.

Demographic implications

As Figure 1 shows, the population density of a village tends to decline monotonically as the distance from NH2 increases for both the baseline and resurvey years. Such a pattern suggests that the villages in the vicinity of the highway have a much better prospect of having diversified economic activities which, among other things, induce a higher population density. Here, it may be pointed out that the level of population density at all distance levels has become higher in the resurvey after the upgradation of the highway. It is, however, more pronounced up to a distance of 3 km, suggesting that ease of commuting also plays a reinforcing role.

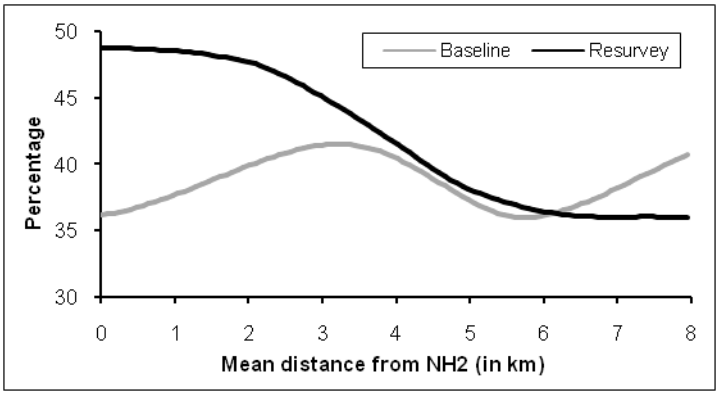
Figure 1: Density of population per sq km



Incidence of poverty

Figure 2 indicates that as per the baseline data, the percentage of households living below the poverty line (BPL) monotonically increases up to a distance of 4 km and then declines. However, in the resurvey data, this percentage remains stable up to a distance of 3 km and then steadily declines with increase in distance. The level of resurvey graph is also considerably lower than that of the baseline graph. This pattern, when studied in relation to the recorded higher density of population, explains the fact that relatively poor tend to stay closer to the highway.

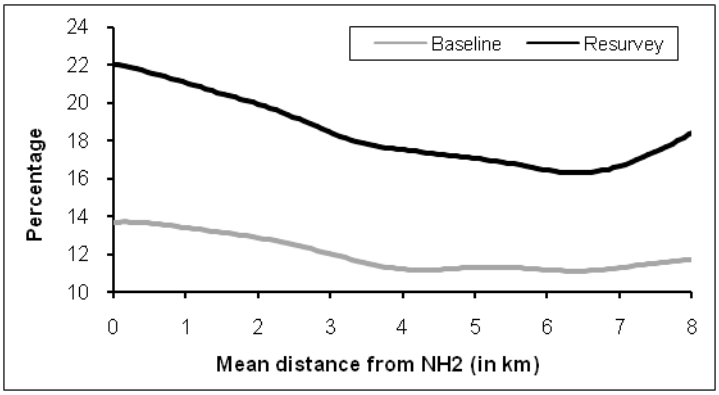
Figure 2: Percentage of BPL households



Transport infrastructure

The graph for the proportion of motorised vehicles (Figure 3) shows a declining trend up to 4.5 km for the baseline data and up to 6.5 km for the resurvey data, beyond which the trend either stabilizes or gets reversed. The level of resurvey graph is also substantively higher than that of the baseline graph. This is as expected since people living in the vicinity of the highway have better economic opportunities.

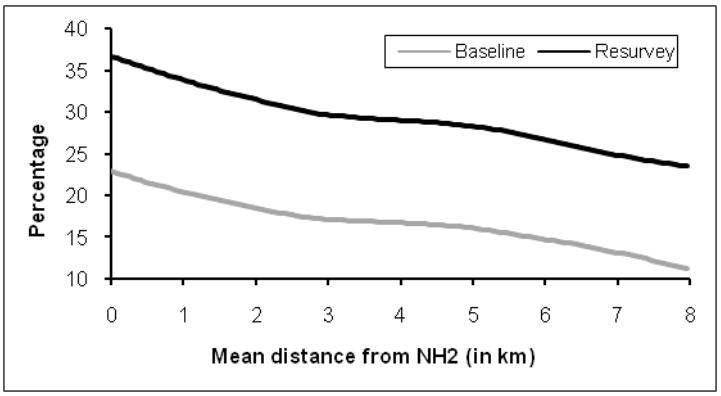
Figure 3: Proportion of motorized transport in total transport



Employment

As Figure 4 shows, the proportion of non-agricultural workers in the total main workers monotonically declines with the distance from NH2 both in the baseline and resurvey data. The resurvey graph further shows higher share of non-agricultural workers for all levels of distance vis-à-vis the baseline graph. This is quite expected, since more non-farm activities generally tend to develop in the vicinity of a highway, thereby providing more of such employment opportunities. The upgradation of the highway is likely to further catalyze these opportunities.

Figure 4: Share of non-agricultural workers in total main workers



Asset ownership

The ownership of milch animals may be regarded as an indicator of the spread of allied agricultural activities in a village. As Figure 5 indicates, the ownership of milch animals per household declines monotonically up to a distance of 3.5 km and then follows an undulating pattern of movement, thus suggesting a flattening of the

curve beyond 3.5 km, on average, in the base year situation. As per the resurvey data, the value of the variable monotonically rises over distance. This is clearly indicative of the spatially penetrating effect of highway upgradation. The inter-sectoral linkage effect may warrant a change in our a priori expectation regarding the nature of such relationship.

Figure 6, on the other hand, presents the graph of the estimated non-parametric regression for the proportion of semi-pucca and pucca houses. The graph tends to decline monotonically up to a distance of around 4 km in the baseline situation and up to 3.5 km for the resurvey situation. It is interesting to note that the level of the proportion has been lower for the resurvey graph up to 4 km, beyond which it has been higher than the baseline graph. This again suggests some higher beneficial impact on distant villages between the two periods, either due to the agrarian development driven by linkage effects on farther places or due to other developmental factors.

Figure 5: Number of milch animals per household

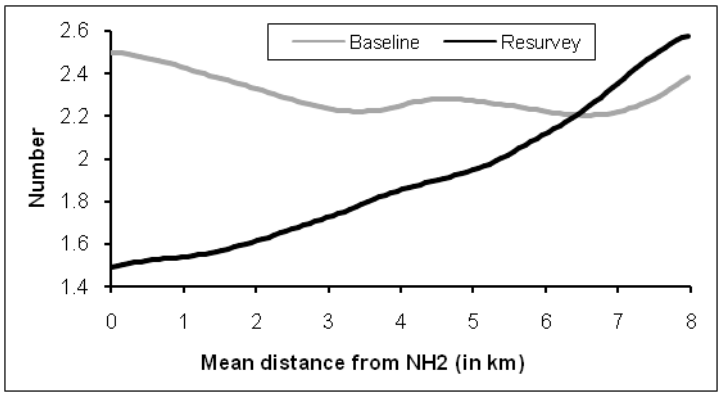
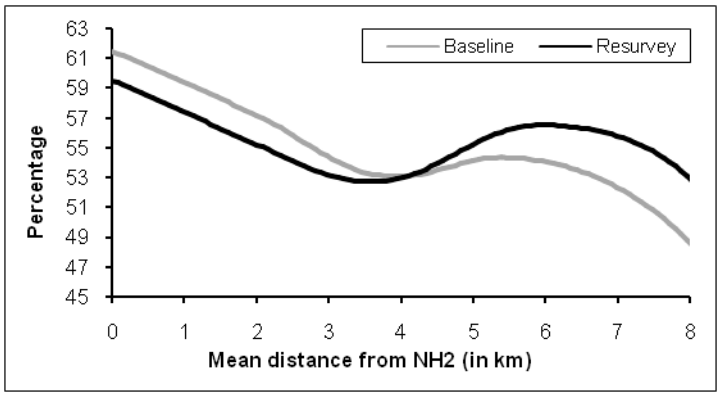


Figure 6: Proportion of semi-pucca/pucca houses



Education and other infrastructure

Figures 7-10 present the non-parametric regression graphs that describe the relationship between the distance from NH2 and the various education-related variables for both the baseline year and the post-project resurvey year. As regards the relationship between the state of educational development and the distance from NH2, the number of teachers per school is seen to decline up to a distance of 5.5 km as per both the baseline graph and the resurvey graph.

Figure 7: Number of teachers per school

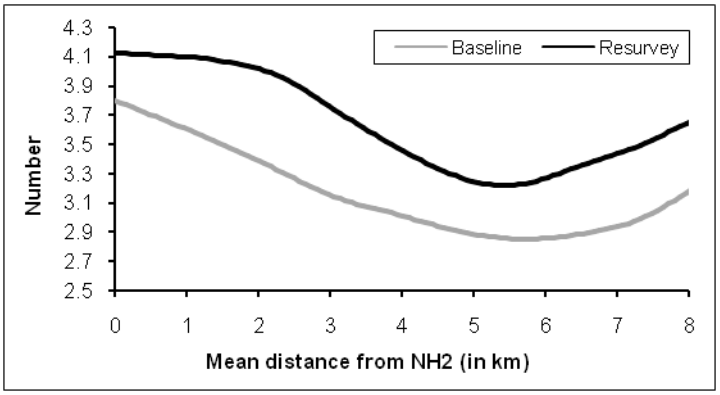


Figure 8: Number of enrolled students per school

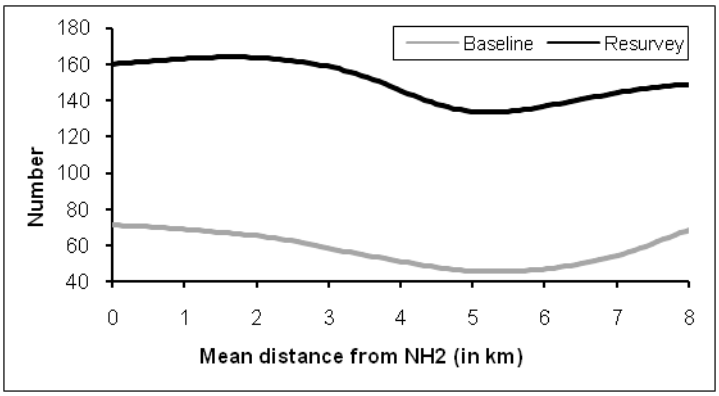
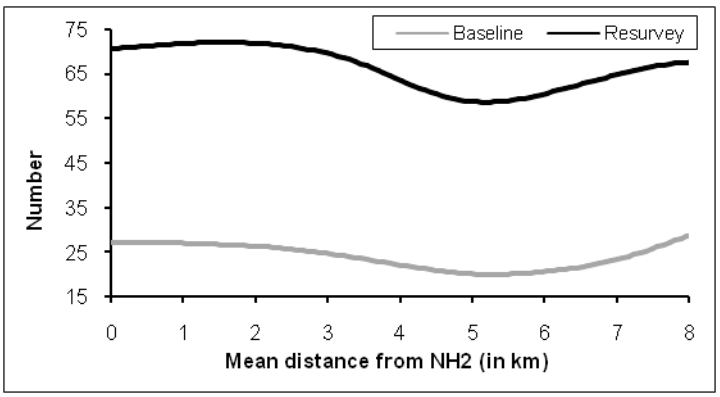


Figure 9: Number of enrolled girl students per school



The enrolment rate of total students and enrolment rate of girl students show a similar declining trend up to 5 km distance for both the periods. The overall rate of literacy in the sample villages also declined mildly up to 3 km in the baseline year and up to 2.5 km in the resurvey year followed by rise in both the graphs. Besides, all the graphs relating to educational attainment show a substantive upward shift in the resurvey year over the base year indicating positive effect of highway upgradation. Thus, both proximity to highway and its level of upgradation are significant factors in educational attainment at rural level.

So far as the availability of banking facilities is concerned (Figure 11), the baseline regression curve declines monotonically up to 5 km and considerably flattens beyond that. The resurvey curve of regression shows mild monotonic rise with distance covering the entire range of 8.5 km of approach distance. For the existence of a cooperative society (Figure 12), on the other hand, the baseline regression graph curve declines monotonically all through, while the resurvey graph shows a rise up to 4 km and then mildly declines with distance.

Figure 10: Percentage of literate population

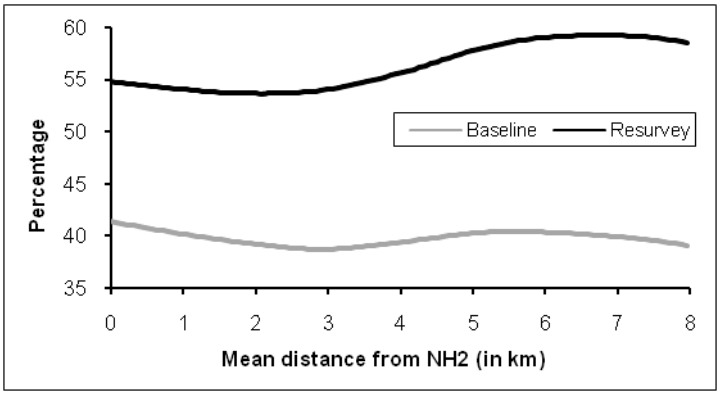


Figure 11: Proportion of villages having banking facilities

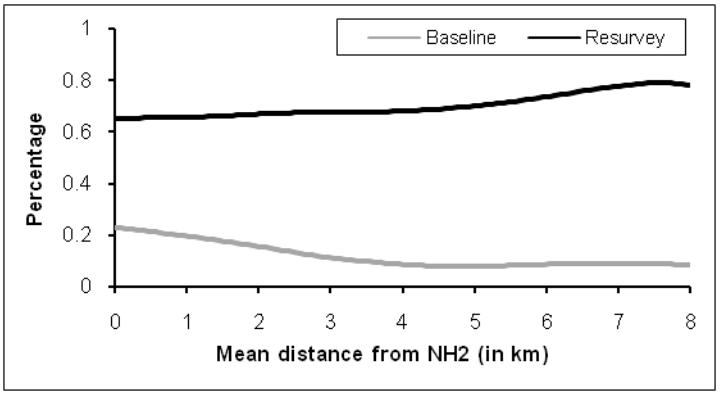
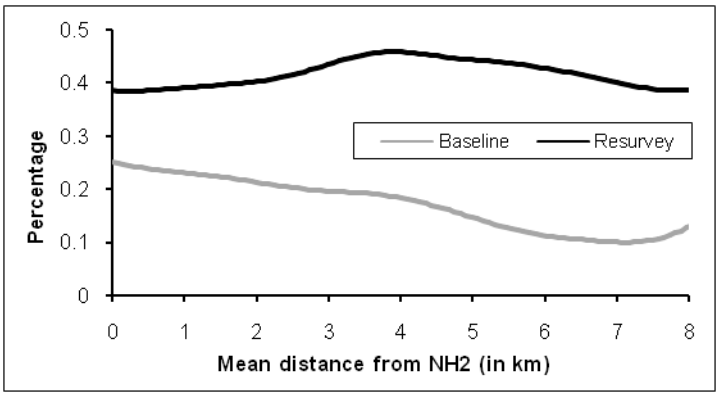


Figure 12: Proportion of villages having a cooperative society



For both the banking facility and the cooperative society institutions, the levels of resurvey graph are substantially higher than those of the baseline graph showing a positive impact of highway upgradation between the two periods.

Prices of land

Figures 13-15 show the nature of variation in the price of irrigated land, unirrigated land and residential land, in relation to the distance from NH2 for both the baseline and resurvey years. It may be noted that, in the case of all the graphs, there is a change of slope somewhere in the range of 4 to 4.5 km distance level beyond which it tends to flatten, particularly as per the resurvey data. In the case of price of residential land (Figure 15), the graph monotonically declines and then the curve flattens at the 4.5-km distance level as per the resurvey data. This suggests that the sensitivity of residential land price to the distance from NH2 is perceptibly stronger for villages located within 4.5 km from NH2. For irrigated crop land, the baseline graph is almost flat while the resurvey one shows a rise in price up to 3 km distance followed by decline. In the case of price of unirrigated crop land, on the other hand, the curves of regression of baseline and resurvey are similar in pattern showing initially a decline with distance followed by a mild rise or almost stable level. However, the higher level of all the three land price

Figure 13: Price of irrigated crop land (Rs./acre)

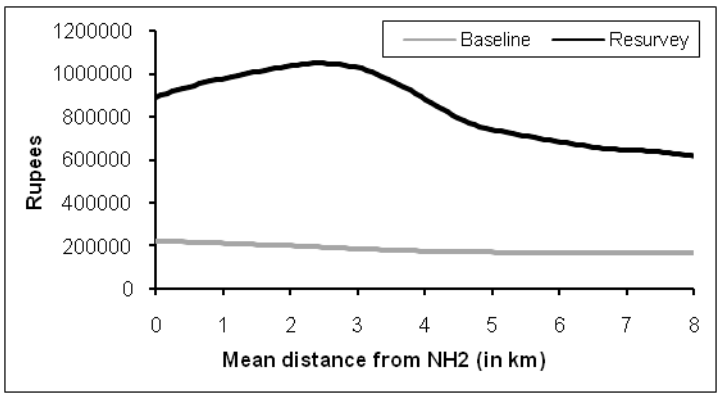


Figure 14: Price of unirrigated crop land (Rs./acre)

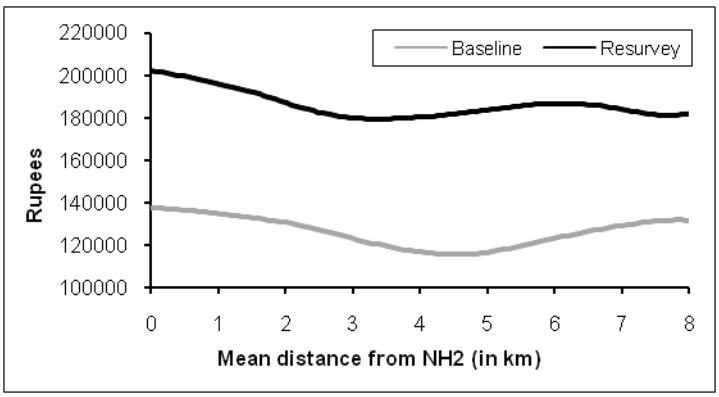
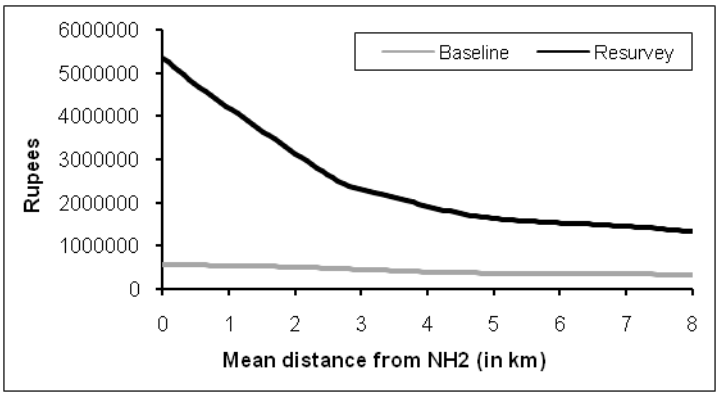


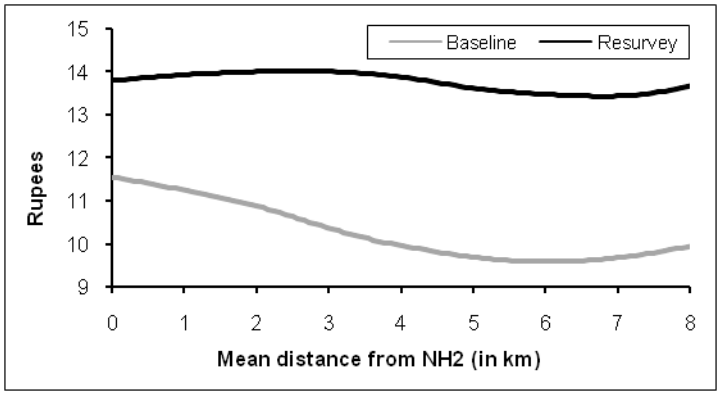
Figure 15: Price of land for residential purpose (Rs./acre)



graphs for the resurvey year over the base year graph shows a definite positive impact of 4-laning or upgradation of NH2.

Finally, in Figure 16, the non-parametric regression graph shows how the sale price of milk varies with distance from NH2. The baseline regression curve is monotonically declining up to 6 km beyond which it mildly rises while the resurvey graph shows more or less flat shape initially followed by a decline up to 6 km beyond which it rises. The level of such price has, however, been found to be higher for all levels of distance in the resurvey situation vis-à-vis the baseline one.

Figure 16: Price of milk per litre



Since none of the price graphs shows any sharp gradient with distance except that of residential land and irrigated crop land in the resurvey situation, the proximity to highway is significant only for land of prime quality and high value use. Price of milk is also independent of location and distance. What matters more for such prices reflecting market development is the level of highway or other infrastructure development, rather than proximity per se.

The results of non-parametric regression analysis have confirmed that proximity to the highway has a positive relationship for most of the well-being/development indicators. The resurvey data shows the desired shift of the level of the curve for most of these chosen indicators. More importantly, in many cases, the gradient of the relationship has shown a marked change around a distance level of 4-5 km, indicating that the effect of the highway on villages located within this approach distance is qualitatively different from that on villages at greater distances.

Comparison of results

Table 5 summarises the results of village level indicators, which have a relationship with proximity to the highway and its upgradation. The different types of analyses are complementary to each other and thus help to obtain robust outcomes.

Table 5: Comparison of results on proximity and upgradation of highway on the socio-economic well-being (indicators at the village level)

Variable		Correlation analysis	Non-parametric curve		Comparison of mean
		If correlation is of expected sign	If gradient is of expected sign	If the shift is of expected nature	If double difference is of expected sign
Demographic					
V1	Population density	✓	✓	✓	✓
Incidence of poverty					
V2	Proportion of BPL households	✓	-	✓	✓
Transport infrastructure					
V3	Share of motorized vehicles in total transport vehicles	✓	✓	✓	✓
Employment					
V4	Proportion of non-agricultural workers in total main workers	✓	✓	✓	✓
Asset ownership					
V5	Number of milch animals per household	-	-	-	-
V6	Proportion of semi-pucca and pucca houses	✓	✓	-	-
Education and other infrastructure					
V7	Number of teachers per school	✓	✓	✓	-
V8	Number of enrolled students per school in the base year	✓	✓	✓	✓
V9	Number of girl students enrolled per school in the base year	✓	✓	✓	✓
V10	Proportion of literate population above 6 years of age	-	-	✓	-
V11	Whether a village has banking facilities	-	-	✓	✓
V12	Whether a village has cooperative society	-	-	✓	✓
Price of land and dairy products					
V13	Price of irrigated crop land (Rs./acre)	✓	-	✓	✓
V14	Price of unirrigated crop land (Rs./acre)	-	✓	✓	-
V15	Price of residential land (Rs./acre)	✓	✓	✓	✓
V16	Sale price of milk (Rs./litre)	-	-	✓	-

Concluding observations

The summary of results firmly suggests that proximity to NH2 and its upgradation has a positive relationship with: (i) demographic characteristics (density of population), (ii) proportion of BPL households (iii) share of motorised transport, (iv) employment in non-farm activities (proportion of non-agricultural workers in total main workers), (v) housing conditions (proportion of semi-pucca and pucca houses in the total number of dwellings), (vi) enrolment of students and also that of girl students, and (vii) price of land (price of irrigated crop land and residential land).

This relationship has brought about a desired shift of the curve for most of the identified village-level indicators of well-being. Furthermore, the gradient of the relationship has a marked turning around at a distance of 4-5 km which happens to be in sync with the hypothesis of the influence zone of the highway on the rural settlements.

The improved job opportunities available in closer proximity to the highway have a significant influence on the demographic characteristics in terms of higher density of population in the nearby villages. In particular, the relatively poor tend to stay closer to the highway because of better job prospects in non-agricultural activities and ease of commuting. This phenomenon has implications for interpreting the gradient of change.

Chapter 5

Impact Evaluation at Household Level

This chapter presents a comprehensive analysis of the household-level data using different statistical/econometric methods. These methods are complementary to one another; hence, their simultaneous use may help in getting robust results. The basic premise underlying the household-level data analysis, as in the case of analysis of village-level data, is that proximity to NH2 would help improve a household's well-being. An improved road infrastructure would further enhance the level of well-being.

Given that the notion of socio-economic well-being is essentially multi-dimensional, a wide array of household-level variables (that are likely to reflect the well-being of the population[1]) have been analyzed to assess if proximity to NH2 leads to significant differences in these variables and also to explore the nature of their individual relationship with distance from NH2. Although poverty is one of the important manifestations of lack of well-being, the present analysis focuses on other indicators driving socio-economic well-being at household level.

Four different techniques have been used for the household-level data analysis – viz., correlation analysis, comparison of means, PSMT[2]-based single difference analysis (SDA) and double difference analysis (DDA) and non-parametric regression analysis (NRA). Of these, the first two constitute the preliminary data analysis. PSMT-based SDA and DDA have been employed to measure impact by comparing average values of outcome variables for households in the influence and control zones. NRA, on the other hand, has been used to explore the nature of relationship of individual outcome variables with distance from NH2.

Household level variables

As mentioned above, proximity to NH2 is expected to affect a household's well-being directly by enhancing mobility and also indirectly by broadening the scope

1. Henceforth, we shall refer to these variables as outcome variables.
2. It may be mentioned here that since the present analysis is based on benchmark survey data, the impact analysis based on the propensity score matching technique (PSMT) is essentially a single difference analysis that compares the average value of an outcome variable for households living in the influence zone, i.e. a defined neighbourhood of NH2 with that of a matched group of households living in the control zone which is away from NH2.

for various socio-economic opportunities. To measure these effects, seven different groups of outcome variables have been considered for the present analysis. These include a set each of (i) alternative measures of the incidence of poverty, (ii) measures of mobility, (iii) certain measures of income, employment and occupation, (iv) variables relating to housing and asset ownership, (v) indicators of access to health, education and other infrastructural facilities, and (vi) attitudinal variables recording a household's perception about its own poverty status and about the possibility of improvement in the range of its employment opportunities due to the proposed expansion of NH2. The total number of variables falling under these seven groups is 29. The list of these variables is given in Table 1.

Table 1: List of variables used to study impact of proximity to NH2 based on the household-level data

Incidence of poverty	
H1*	Whether household is poor based on poverty line measured in terms of monthly per capita income (MPCY)
H2*	Whether household is poor based on poverty line measured in terms of monthly per capita consumption expenditure (MPCE)
Mobility (weekly)	
H3	Per capita trip rate (PCTR)
H4	Per capita trip rate for work
H5	Per capita trip rate for marketing
H6	Per capita trip rate for education
H7	Per capita trip rate for accessing health-related services
H8	Per capita trip rate involving travel on NH2
H9	Per capita trip length for trips involving NH2
H10	Per capita travel expense for trips involving NH2
H11	Per capita travel time for trips involving NH2
H12	Travel cost per person km for trips involving NH2
Income, employment and occupation	
H13	Per capita income (annual) (Rupees)
H14	Per capita consumption expenditure (monthly) (Rupees)
H15	Share of income from self-employment in non-agricultural activities
H16	Share of food in consumption expenditure
H17	Proportion of working members in a household in age group 15-59 years
H18	Proportion of working female members in a household in age group 15-59 years
H19	Proportion of non-agricultural workers in total working household members.
Asset ownership	
H20*	Whether a household is landless
H21*	Whether a household owns at least one information related consumer durable (like TV, radio, etc.)
H22*	Whether a household owns at least one motorised transport vehicle
Education and health	
H23	Proportion of school-going children among all children in the household in age group 6-14 years
H24	Proportion of female school-going children among all female children in the household in age group 6-14 years
H25	Proportion of household members who availed of medical facilities during the last six months
Attitudinal response	
H26*	Whether a household rates itself as poor
H27*	Whether a household expects improvement in employment situation after 4-laning of NH2
Well-being index	
H28	Index of overall well-being based on income, employment, health and education
H29	Index of access to infrastructural facilities, assets and amenities

* These are qualitative binary variables

Correlation analysis

For a preliminary analysis, the pattern of interdependence among the chosen variables has been examined using the simple correlation coefficient between pairs of variables. The computed correlation matrix is presented in Table 2. It shows that the correlation with H0 (i.e. distance from NH2) is significant with the expected sign* for eleven variables – H3, H4, H6, H8, H10, H11, H15, H19, H20, H27 and H28. Importantly, nine of these correlations (viz. all except the ones with H6 and H27) were also found to be statistically significant in the analysis of baseline survey data. It also shows that, except in a few cases, the correlation between pairs of chosen outcome variables is not strong, which suggests that, by and large, the chosen outcome variables reflect aspects of well-being that are not related to one another.

The pattern of correlation between pairs of outcome variables also provides certain useful insights. The mobility-related variables per capita trip rate for work (H4) and per capita trip rate for education (H6) are both positively correlated with per capita trip rate (H3), suggesting that trips are mostly made for work and education purposes. The variables H8-H11, all of which involve travel on NH2, are also positively correlated with one another signifying that proximity to NH2 leads to more frequent and longer trips.

In the group of variables relating to income, employment and occupation, two systematic relations may be noticed. The pattern of pair-wise correlation for per capita income (H13), per capita consumption expenditure (H14) and share of food in consumption expenditure (H16) are on the expected lines. The correlation between the proportion of working members in a household in the age group 15-59 years (H17) and the corresponding variable for working female household members (H18) is also positive, suggesting that a higher female workforce participation would lead to a higher overall labour force participation.

The variables relating to education, viz., proportion of school-going children among children in the age group 6-14 years (H23) and the corresponding variable relating to education of female children (H24) are highly positively correlated. This is only to be expected, because a higher schooling rate for female children would push up the overall schooling rate.

* Positive or negative depending on the variable.

Table 2: Correlation matrix of follow up outcome variables (households)

	H0	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12	H13	H14	H15	H16	H17	H18	H19	H20	H21	H22	H23	H24	H25	H26	H27	H28	H29
H0	1.00																													
H1	-0.01	1.00																												
H2	-0.01	0.55	1.00																											
H3	-0.0752*	-0.19	-0.17	1.00																										
H4	-0.0794*	-0.03	-0.04	0.60	1.00																									
H5	0.03	-0.06	-0.06	0.19	-0.31	1.00																								
H6	-0.0414*	-0.16	-0.12	0.49	-0.04	-0.11	1.00																							
H7	-0.01	-0.06	-0.06	0.11	-0.10	-0.12	-0.03	1.00																						
H8	-0.1302*	-0.09	-0.10	0.56	0.38	0.07	0.21	0.07	1.00																					
H9	-0.03	-0.06	-0.06	0.10	0.06	-0.07	0.05	0.03	0.21	1.00																				
H10	-0.0534*	-0.06	-0.06	0.05	0.00	-0.04	0.04	0.00	0.09	0.37	1.00																			
H11	-0.1159*	-0.09	-0.10	0.29	0.20	-0.08	0.13	0.06	0.54	0.58	0.28	1.00																		
H12	0.01	-0.13	-0.10	-0.01	-0.05	-0.02	0.05	-0.01	-0.05	0.05	0.57	0.03	1.00																	
H13	0.00	-0.20	-0.20	0.11	0.04	0.00	0.08	0.01	0.08	0.10	0.14	0.10	0.09	1.00																
H14	-0.01	-0.20	-0.15	0.12	0.01	0.03	0.12	-0.01	0.07	0.09	0.18	0.07	0.13	0.34	1.00															
H15	-0.1126*	0.29	0.19	0.03	0.17	-0.07	-0.11	-0.03	0.05	0.01	-0.04	0.04	-0.13	-0.12	-0.11	1.00														
H16	0.01	0.39	0.22	-0.12	-0.02	0.04	-0.18	0.00	-0.06	-0.07	-0.15	-0.07	-0.19	-0.26	-0.52	0.14	1.00													
H17	0.01	0.10	0.05	0.11	0.16	0.08	-0.13	0.00	0.08	-0.02	-0.05	0.02	-0.06	-0.09	-0.04	0.15	0.04	1.00												
H18	0.01	0.05	0.04	0.15	0.12	0.03	0.03	0.00	0.07	-0.02	-0.03	0.03	-0.05	-0.07	-0.03	0.09	-0.03	0.81	1.00											
H19	-0.1343*	0.16	0.11	0.02	0.18	-0.12	-0.09	-0.04	0.05	0.01	-0.03	0.03	-0.12	-0.07	-0.07	0.58	0.11	-0.08	-0.20	1.00										
H20	-0.0680*	0.25	0.20	0.05	0.14	-0.01	-0.10	0.00	0.01	-0.02	-0.04	-0.03	-0.10	-0.14	-0.15	0.50	0.20	0.21	0.21	0.35	1.00									
H21	-0.01	-0.18	-0.16	-0.04	-0.04	-0.09	0.09	-0.06	-0.02	0.02	0.05	-0.01	0.09	0.12	0.09	-0.14	-0.14	-0.16	-0.14	0.00	-0.12	1.00								
H22	0.02	-0.33	-0.27	-0.02	-0.07	-0.08	0.12	-0.02	0.01	0.05	0.11	0.02	0.24	0.29	0.30	-0.27	-0.44	-0.20	-0.16	-0.16	-0.29	0.34	1.00							
H23	0.00	-0.14	-0.09	-0.01	-0.07	-0.03	0.08	0.01	-0.01	0.03	0.03	0.00	0.07	0.12	0.07	-0.14	-0.11	-0.17	-0.10	-0.12	-0.20	0.08	0.13	1.00						
H24	0.01	-0.18	-0.11	0.04	-0.03	-0.03	0.07	-0.01	-0.02	0.02	0.03	-0.01	0.08	0.11	0.06	-0.14	-0.11	-0.16	-0.11	-0.09	-0.18	0.07	0.12	0.90	1.00					
H25	-0.02	-0.15	-0.13	0.19	0.03	0.20	0.02	0.15	0.02	-0.03	-0.01	0.00	0.03	0.02	0.02	0.01	-0.05	0.23	0.28	-0.06	0.08	-0.02	-0.10	-0.06	-0.03	1.00				
H26	-0.01	0.32	0.27	0.04	0.10	0.06	-0.07	-0.01	0.00	-0.07	-0.05	-0.06	-0.10	-0.17	-0.16	0.32	0.22	0.20	0.17	0.17	0.40	-0.15	-0.36	-0.16	-0.16	0.13	1.00			
H27	0.0695*	-0.04	0.01	0.01	-0.06	0.09	0.08	-0.05	-0.01	0.00	-0.01	-0.03	0.00	0.06	0.09	-0.21	-0.09	-0.11	-0.09	-0.20	-0.19	0.11	0.18	0.03	0.02	-0.08	0.01	1.00		
H28	-0.07*	0.07	0.10	0.10	0.13	0.00	-0.03	0.02	0.04	0.00	0.01	0.03	-0.02	-0.02	0.25	0.57	-0.10	0.53	0.46	0.24	0.31	-0.09	-0.15	0.31	0.24	0.44	0.22	-0.16	1.00	
H29	0.01	0.04	0.04	0.03	0.03	-0.03	0.03	-0.02	-0.02	-0.03	0.00	-0.04	-0.01	0.00	0.02	0.03	-0.02	0.04	0.04	-0.01	-0.02	0.00	0.01	0.01	0.02	0.04	0.03	0.06	0.07	1.00

* Significant at 5 percent level with the distance from the highway. H0 denotes approach distance from a household

Comparison of means

As a preliminary analysis, whether mean values of individual variables for influence and control zones are equal has been examined by testing for each variable the null hypothesis that population means for two zones are equal[3]. This comparison of overall means should provide a preliminary idea about the difference in average levels of the influence and control zones for different variables. Table 3 gives baseline and resurvey means of the selected outcome variables separately for sample households falling in influence and control zones, taking the 5 km distance based delineation of the influence zone. The table also provides (i) the difference of means of the two zones for baseline survey and resurvey, which should be a crude measure of the impact of proximity to NH2, and (ii) the difference of these differences, which should similarly be a crude double difference measure of the impact of upgrading of NH2.

As Table 3 shows, means of the influence and control zones are different for 10 out of 29 variables for the resurvey data. For 7 out of these 11 variables, the difference of means is also found for the baseline survey data. These 7 variables are H3, H4 and H8 related to mobility, H15 and H19 related to income, employment and occupation, H20 related to asset ownership, and H27 related to attitudinal response. Significant mean difference is observed for H6, H11 and H25 only for resurvey data and for H26 only for the baseline survey data. These results thus reinforce the basic neighbourhood premise for studying the effects of proximity to NH2 on the well-being of the population.

Comparison of the baseline and resurvey means shows that for 17 out of 29 variables both influence zone and control zone means have improved in the resurvey data, some of the improvements being fairly large (e.g. trip rate for marketing and health, proportion of working female members, ownership of information related consumer durables and motorized transport vehicle, etc.). These improvements in the means, however, may not be entirely due to the upgrading of NH2.

Finally, the double differences (i.e. the difference of baseline and resurvey differences of sample means of influence zone and control zone) given in column 7 of Table 3 suggest the following: For 9 of the 29 outcome variables, this crude measure of impact of NH2 widening shows expected positive impact, among which are some related to mobility (H3, H6, H8 and H11), some to income, employment and occupation (H15 and H19), some to health (H25) and overall wellbeing (H28).

3. The significance of means has been tested using t-test.

Table 3: Sample mean of outcome variables for influence zone and control zone and their comparison: Baseline survey and resurvey

	Variable	Mean value (Baseline)		Baseline difference of influence zone and control zone means (1) - (2)	Mean value (Resurvey)		Resurvey difference of influence zone and control zone means (4) - (5)	Double difference between influence zone and control zone	Percentage increase of resurvey over the baseline
		Influence zone	Control zone		Influence zone	Control zone			
		1	2	3	4	5	6	7	8
Incidence of poverty									
H1	Proportion of poor households based on poverty line measured in terms of MPCY	36.86	38.88	-2.02	31.9	30.31	1.59	3.61	178.71
H2	Proportion of poor households based on poverty line measured in terms of MPCE	45.23	46.73	-1.5	40.83	38.85	1.98	3.48	232.00
Mobility									
H3	Per capita trip rate (PCTR)	0.89	0.79	0.09*	1.3	1.16	0.14*	0.05	55.56
H4	Per capita trip rate for work	0.55	0.41	0.14*	0.55	0.43	0.13*	-0.01	-7.14
H5	Per capita trip rate for marketing	0.1	0.09	0.01	0.34	0.37	-0.03	-0.04	-400.00
H6	Per capita trip rate for education	0.21	0.25	-0.04	0.28	0.22	0.06*	0.11	250.00
H7	Per capita trip rate for accessing health-related services	0.01	0.02	-0.01	0.06	0.06	-0.01	-0.01	0.00
H8	Per capita trip rate involving travel on NH2	0.42	0.23	0.18*	0.67	0.46	0.21*	0.03	16.67
H9	Per capita trip length for trips involving travel on NH2	3.74	3.28	0.46	6.59	5.15	1.44	0.97	213.04
H10	Per capita travel expenses for trips involving travel on NH2 (Rs.)	1.16	0.94	0.22	5.74	2.29	3.45	3.23	1468.18
H11	Per capita travel time for trips involving travel on NH2 (minutes)	18.18	15.51	2.67	21.6	14.25	7.34*	4.67	174.91
H12	Travel cost per person km for trips involving travel on NH2 (Rs.)	0.000024	0.000042	-0.000018	0.000063	0.000061	0.000002	0.00002	111.11
Income, employment and occupation									
H13	Per capita annual income (Rs.)	8143.67	7900.23	243.44	11959.41	12046.93	-87.53	-330.96	-135.96
	Deflated per capita annual income (Rs.)	8143.67	7900.23	243.44	8996.84	9053.22	-56.38	-299.81	-123.16
H14	Per capita monthly consumption expenditure (Rs.)	552.79	598.14	-45.34	1101.75	1148.87	-47.12	-1.78	-3.93
	Deflated per capita monthly consumption expenditure (Rs.)	552.79	598.14	-45.34	757.95	791.59	-33.64	11.7	25.81
H15	Share of income from self-employment in non-agricultural activities	58.64	54.13	4.51*	58.38	52.98	5.39*	0.88	19.51
H16	Share of food in consumption expenditure	40.59	37.43	3.16	40.33	40.19	0.15	-3.01	-95.25
H17	Proportion of working members in a household in age group 15-59 years	49.43	48.37	1.06	54.24	53.95	0.29	-0.77	-72.64
H18	Proportion of working female members in a household in age group 15-59 years	8.73	8.32	0.41	22.69	22.06	0.64	0.22	56.10
H19	Proportion of non-agricultural workers in total working household members.	56.0442	48.4786	7.57*	63.01	55.27	7.74*	0.17	2.25
Asset ownership									
H20	Proportion of landless households	39.4963	35.74701	3.75*	38.1	32.57	5.53*	1.78	47.47
H21	Proportion of households owning at least one information related consumer durable	15.491	15.11748	0.37	70.86	70.74	0.12	-0.25	-67.57
H22	Proportion of households owning at least one motorised transport vehicle	10.5076	11.17186	-0.66	25.31	27.33	-2.01	-1.35	-204.55
Education and health									
H23	Proportion of school-going children among all children in age group 6-14 years	82.8477	84.97375	-2.13	90.25	90.62	-0.37	1.75	82.63

	Variable	Mean value (Baseline)		Baseline difference of influence zone and control zone means (1) - (2)	Mean value (Resurvey)		Resurvey difference of influence zone and control zone means (4) - (5)	Double difference between influence zone and control zone	Percentage increase of resurvey over the baseline
		Influence zone	Control zone		Influence zone	Control zone			
		1	2	3	4	5	6	7	8
H24	Proportion of female school-going children among all female children in age group 6-14 years	78.0401	79.59479	-1.55	89.64	90.86	-1.23	0.33	20.65
H25	Proportion of household members who availed of medical facilities during last six months	13.4049	12.78262	0.62	20.52	19.21	1.31*	0.69	111.29
Attitudinal response									
H26	Proportion of households who rate themselves poor or very poor	45.23	46.73	-1.5*	39.77	37.72	2.05	3.54	236.67
H27	Proportion of households who expect improvement in employment situation after 4-laning of NH2	76.8755	76.32629	0.55*	72.05	76.15	-4.09*	-4.64	-843.64
Well-Being index									
H28	Index of overall well-being based on income, employment, health and education	0.3993	0.3885	0.0108	0.4441	0.421	0.0231	0.0123	13.88889
H29	Index of access to infrastructural facilities, assets and amenities	0.3563	0.3562	0.0001	0.4223	0.4309	-0.0086	-0.0087	-8800

Note: *denotes significance at 5 percent level

Difference analysis based on PSMT

As explained in Chapter 1, the propensity score matching technique (PSMT) may help measure the impact on individual outcome variables. Briefly, for every sample household in the influence zone, PSMT identifies a (set of) matched (i.e., comparable) sample household(s) in the control zone and for each outcome variable computes sample averages for influence zone households and corresponding matched sample of control zone households and then compares these two sample averages[4].

PSMT involves two steps. In the first step, a binary logit analysis is performed (based on the entire sample of households) to estimate for each sample household (irrespective of whether it belongs to the influence zone or the control zone) the probability of its being located in the influence zone, given the observed values of relevant household characteristics, etc. Using these estimated probabilities and an appropriate distance criterion, a set of matched control zone sample households for each influence zone sample household is identified[5]. In the second step, for every

4. See Chapter 1 on Methodology for a more detailed explanation.
5. To be specific, for each influence zone sample household, the corresponding matched sample households of the control zone have been identified by using the odds ratio for a household for being an influence zone household. Suppose P is the estimated propensity score of an influence zone sample household and P_c is that for a control zone sample household. Denote the corresponding odds ratios as $\pi = P/(1-P)$ and $\pi_c = P_c/(1-P_c)$. If $(\pi - \pi_c)^2 \leq 0.005$, then the control zone sample household is chosen as the matched household for the influence zone household under consideration. Using this criterion, for each influence zone household, matched households have been found out.

outcome variable, the averages of sample values for the influence zone and the corresponding control zone *matched* sample are computed. The difference between these two computed averages is taken as estimated impact on the particular variable. The estimated logit model, based on which PSMT has been performed, is presented in Appendix 1.

It may be noted that the set of explanatory variables of the above-mentioned estimated logit model mostly include household attributes. Some of these may be regarded as endogenous variables in the sense that these are partly determined by the category to which a sample household belongs (in the present case, these categories are whether a household is in the influence zone or control zone). Normally, such endogeneity problems of explanatory variables would bias the impact estimator. If the households had the option to choose their location, the ideal set of explanatory variables for the logit model would have been the variables inducing that choice. However, in the present case, households have not chosen their location, but happen to be located where they are. Since a choice is absent, the cause-effect relationship between the qualitative dependent variable and whatever explanatory variables are chosen is bound to be blurred. For example, whether a household is poor because it is in the control zone or it is in the control zone because it is poor cannot be ascertained. Given the artificiality of PSMT in the present case, the endogeneity issue appears to be somewhat ill-defined.

Table 4 gives estimated impact measures obtained as PSMT-based single and double differences for individual outcome variables, taking the influence zone to be of 5 km distance delineation. It may be noted that the baseline and resurvey (single) difference between influence zone and control zone given in columns 3 and 6, respectively, are supposed to measure the impact of proximity to NH2 before and after upgrading of NH2, and hence the double difference estimate of column 7 is supposed to be a measure of the impact of upgrading of NH2. It may also be noted that this procedure of PSMT-based impact measurement through double difference assumes that (i) upgrading of NH2 is the only intervention and this affects influence zone alone and (ii) there has been no intervention affecting control zone households alone[6].

6. Clearly these are strong assumptions and their violation will introduce bias in the double difference impact measures.

Table 4: Impact on outcome variables of proximity to NH2 and its upgrading: PSMT-based single and double difference results

	Variable	PSMT-based mean value (Baseline)		Baseline difference between influence zone and control zone (1) - (2)	PSMT-based mean value (Resurvey)		Resurvey difference between influence zone and control zone (4) - (5)	Double difference between influence zone and control zone
		Influence zone	Control zone		Influence zone	Control zone		
		1	2	3	4	5	6	7
Incidence of poverty								
H1	Proportion of poor households based on poverty line measured in terms of MPCY*	36.43	38.27	-1.84	41.46	39.33	2.14	3.97
H2	Proportion of poor households based on poverty line measured in terms of MPCE*	45.75	48.23	-2.48	32.61	30.58	2.03	4.51
Mobility								
H3	Per capita trip rate (PCTR)	0.87	0.79	0.08	1.28	1.15	0.13	0.05
H4	Per capita trip rate for work	0.52	0.41	0.11	0.53	0.40	0.13	0.02
H5	Per capita trip rate for market	0.1	0.09	0.01	0.35	0.38	-0.03	-0.04
H6	Per capita trip rate for education	0.22	0.25	-0.03	0.28	0.24	0.04	0.07
H7	Per capita trip rate for accessing health related services#	0.01	0.01	0	0.06	0.07	-0.01	-0.01
H8	Per capita trip rate involving travel on NH2	0.40	0.25	0.16	0.67	0.45	0.22	0.06
H9	Per capita trip length for trips involving travel on NH2	3.50	3.17	0.33	5.41	4.59	0.83	0.50
H10	Per capita travel expenses for trips involving travel on NH2 (Rs.)	0.91	0.79	0.13	2.24	2.28	-0.03	-0.16
H11	Per capita travel time for trips involving travel on NH2 (minutes)	17.24	15.70	1.54	21.33	13.08	8.25	6.71
H12	Travel cost per person km for trips involving travel on NH2 (Rs.)	0	0	0.000023	0	0	0.000034	0.000011
Income, employment and occupation								
H13	Per capita annual income (Rs.)	8231.92	7932.61	299.31	12038.67	12150.34	-111.67	-410.98
	Deflated per capita annual income# (Rs.)	8231.92	7932.61	299.31	9052.29	9148.74	-96.45	-395.77
H14	Per capita monthly consumption expenditure (Rs.)	559.58	628.65	-69.07	12594.36	14432.86	-1838.49	-1769.42
	Deflated per capita monthly consumption expenditure# (Rs)	559.58	628.65	-69.07	722.61	827.85	-105.24	-36.17
H15	Share of income from self-employment in non-agricultural activities	57.11	55.87	1.24	57.37	52.37	5	3.76
H16	Share of food in consumption expenditure	40.09	35.4	4.69	42.15	38.31	3.84	-0.85
H17	Proportion of working members in a household in age-group 15-59 years#	49.18	48.54	0.64	54.08	53.85	0.23	-0.41
H18	Proportion of working female members in a household in age-group 15-59 years	8.33	8.05	0.28	22.72	22.2	0.51	0.24
H19	Proportion of non-agricultural workers in total working household members	53.81	48.49	5.32	60.21	54.60	5.61	0.30
Asset ownership								
H20	Proportion of landless households	37.36	36.64	0.73	37.58	32.44	5.14	4.41
H21	Proportion of households owning at least one information-related consumer durable#	16.08	15.91	0.17	70.34	71.29	-0.95	-1.12
H22	Proportion of households owning at least one motorised transport vehicle#	9.94	11.26	-1.32	25.22	27.53	-2.31	-0.99

	Variable	PSMT-based mean value (Baseline)		Baseline difference between influence zone and control zone (1) - (2)	PSMT-based mean value (Resurvey)		Resurvey difference between influence zone and control zone (4) - (5)	Double difference between influence zone and control zone
		Influence zone	Control zone		Influence zone	Control zone		
		1	2	3	4	5	6	7
Education and health								
H23	Proportion of school-going children among all children in age-group 6-14 years	83.21	86.41	-3.20	90.19	91.83	-1.65	1.55
H24	Proportion of female school-going children among all female children in age-group 6-14 years	78.02	82.41	-4.39	89.27	91.83	-2.56	1.83
H25	Proportion of household members who availed of medical facilities during last six months#	13.34	12.68	0.66	19.85	19.74	0.10	-0.56
Attitudinal response								
H26	Proportion of households who rate themselves poor or very poor	41.14	42.95	-1.82	39.48	36.74	2.74	4.55
H27	Proportion of households who expect improvement in employment situation after 4-laning of NH2#	78.70	75.46	3.24	73.37	75.42	-2.05	-5.29
Well-Being index								
H28	Index of overall well-being based on income, employment, health and education	0.4114	0.4064	0.005	0.4591	0.4371	0.022	0.017
H29	Index of access to infrastructural facilities, assets and amenities#	0.34	0.3398	0.0002	0.4147	0.4204	-0.0057	-0.0059

* : double difference not meaningful # : double difference not expected

The following observations may be made from the data contained in Table 4 above:

In 18 out of 29 cases, the double difference measures show positive impact of NH2 upgrading. These include all the mobility-related variables except one and 4 of the 5 employment-related variables (viz. H17 for which the resurvey single difference has been smaller), those relating to education of both male and female children, and non-agricultural employment and earning. These are suggestive of perceptible structural changes taking place in the local economies of the NH2 neighbourhood.

However, there are a few exceptions, notably the one relating to poverty variables H1 and H2, for which the resurvey means for influence zone are larger[7]. This exception could be caused by the effect of simultaneity, omission of which may introduce bias in double difference impact measures. For example, in the present impact study, poverty incidence, i.e. probability of a household being poor, is perhaps

7. Note that the poverty incidence increased for both the zones and hence the unexpected result.

the most important household level outcome variable, for which unexpected negative results have been obtained.

Now, poverty status of households would crucially depend on, say, the probability of getting employed which, in turn, would depend on labour market conditions. If NH2 upgrading has led to significant immigration to the influence zone and hence created excess supply in the local labour markets, the effect may be a relatively larger increase of poverty incidence in the influence zone via increased population density and corresponding changes in the labour market.

As the single difference results (viz. columns 3 and 6) show, the mean of the poverty variable H1 is larger for influence zone for both baseline and resurvey and in case of variables H13 and H14 (i.e. deflated per capita income and consumer expenditure), the resurvey means for control zone are larger and hence the double difference has failed to show the expected results.

Non-parametric regression analysis (NRA)

A working hypothesis running through the present exercise has been the gradient change hypothesis used to delineate the influence zone. In the context of upgrading of NH2, whether the upgrading would leave the delineated influence zone intact is an important concern which deserves investigation. NRA is a convenient and objective procedure for verifying this. The results of this technique supplement the PSMT-based impact results. There is, however, a basic qualitative difference between the two procedures. Whereas the impact measured by PSMT is in principle an estimate of the partial effect of proximity to NH2 or its upgrading (because of the use of matched sets of households of control zone for computing impact), NRA, being a bi-variate procedure, would measure the total effect on the variable concerned. In what follows, the developmental implications of the NRA results for individual outcome variables are discussed.

Incidence of poverty

For obvious reasons, for countries like India, the impact of a public investment project on poverty is considered to be of utmost importance. One would expect a gain due to proximity to NH2 and its widening to accrue to households as access to NH2 should promote income generation by stimulating economic activities via various

linkage effects[8]. To put it differently, between two households with similar attributes and resource endowments, one located in the influence zone and the other in the control zone, the probability of the former being poor should be lower as this household would be able to utilize resource endowments better due to greater accessibility and mobility provided by its proximity to NH2. Widening of NH2 is likely to increase the difference of this probability for a household of control zone vis-à-vis that for an influence zone household.

Given the importance of incidence of poverty as an outcome variable for this impact study, care has been taken to have this variable measured satisfactorily. As already mentioned, two different measures of poverty based on MPCY (H1) and MPCE (H2) are considered here. Note that, whether the MPCY or MPCE should be used to measure the poverty incidence has been an issue of intense debate in the country. Use of consumer expenditure data is preferred by many for two reasons – (i) consumer expenditure relates more directly to nutritional deprivation, which is a major dimension of absolute poverty, and (ii) compared to income, consumer expenditure data collected through household survey may be more reliable as a measure of well-being. Standard arguments put forward in this context relate to greater recall lapse and the tendency to underreport in case of income.

For MPCE-based poverty variable H2, the official poverty line has been adopted. Using this, a sample household is classified if its MPCE is found below the poverty line. The poverty lines for the concerned states given by the Planning Commission with appropriate indexation for price level changes have been used. The poverty line in terms of MPCY has been estimated by inverse interpolation. Thus, using the observed MPCE and MPCY data, a log-linear consumption function is estimated by regressing the logarithm of MPCE on the logarithm of MPCY. Then the MPCY corresponding to the given poverty line in terms of MPCE is calculated from the fitted consumption function. These estimated MPCY values are used as poverty lines in terms of income.

Figures[9] 1 and 2 give the NPR graphs for poverty variables H2 and H1, respectively. One would expect these graphs to rise with distance from NH2 and/or to

8. As mentioned elsewhere, a road development is expected to generate important general equilibrium effects at the national or state level, in addition to major local effects. In an impact analysis based on household/village-level data, one may expect to find out these local effects only.
9. Distances are plotted against X-axis for all the figures.

be rising after the impact of NH2 has vanished, unless effect of some other influence/intervention induces a change of gradient. Given this, the shape of these graphs suggests the following: (1) The influence zone may have changed from 5.5 to 7 km for H1 and from 5.5 to 7 km for H2; and (2) For both H1 and H2, the resurvey graph is lower at all distances – which is consistent with the expected beneficial impact of widening of NH2 on poverty incidence.

Figure 1: Proportion of poor households based on poverty line measured in terms of MPCY

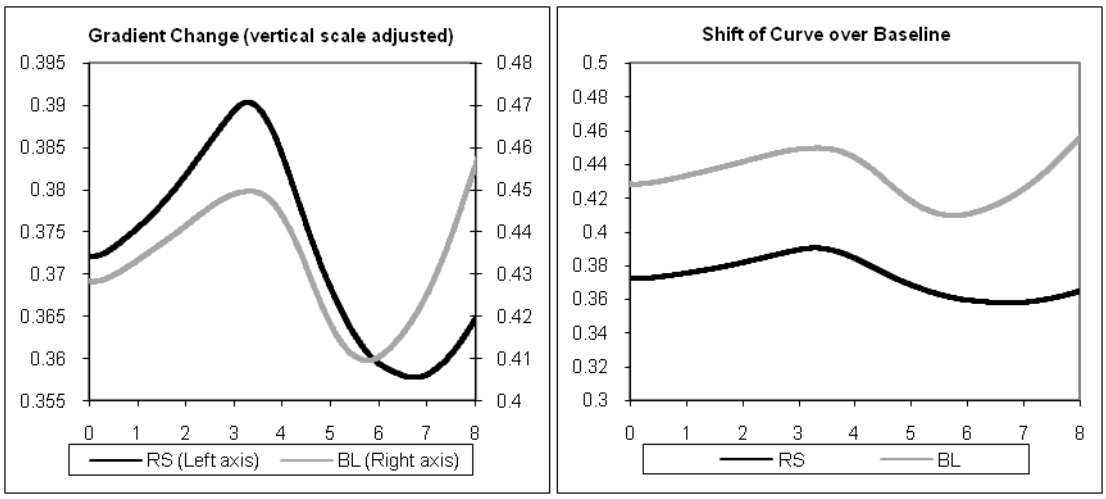
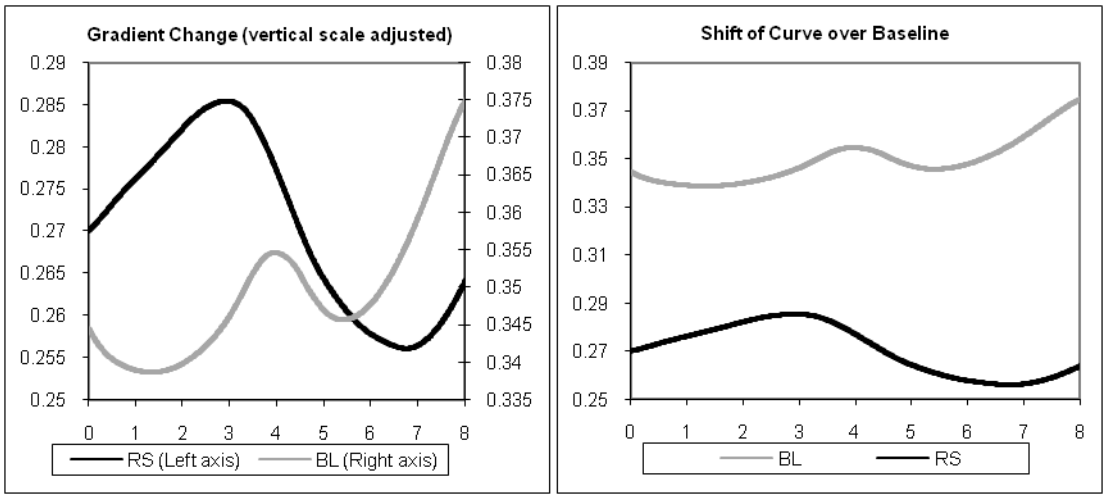


Figure 2: Proportion of poor households based on poverty line measured in terms of MPCE

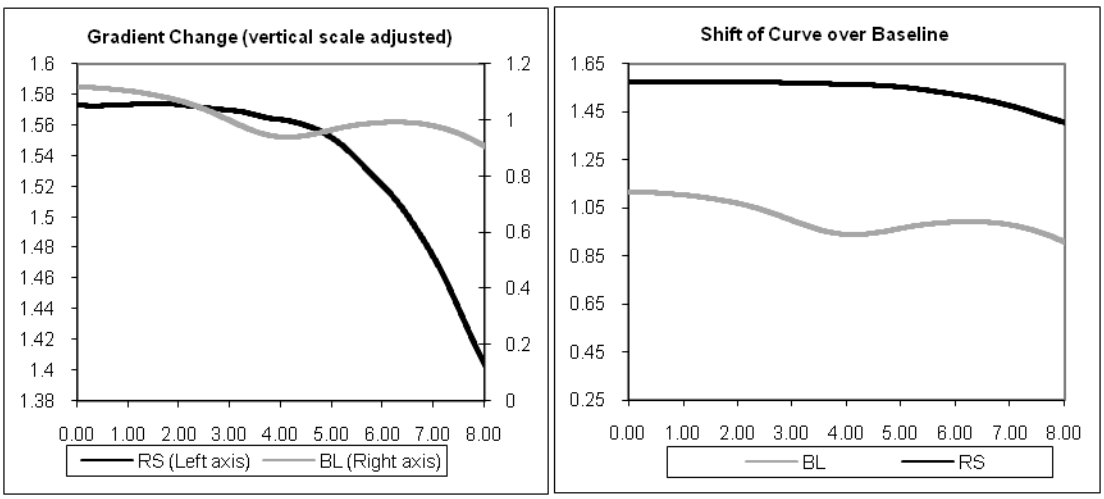


Mobility

The direct economic benefits of proximity to NH2 should arise out of enhanced mobility of people. A household living close to NH2 should have greater movement for work, business, education and health, etc. and so a larger per capita trip rate, compared to a household, otherwise similar, but not having access to NH2. We

have seen that 6 out of the 10 mobility-related variables, viz. H3, H4, H6, H8, H10 and H11, show significant negative correlation with distance from NH2 for both baseline and resurvey data and the strength of this correlation has increased between the surveys for all of them.

Figure 3: Per capita trip rate



Figures 3-12 give the NPR graphs for the 10 mobility-related variables (viz. H3 to H12). A careful examination of these graphs would suggest the following conclusions: Mobility has substantially increased after NH2 widening, except for trips involving direct use of NH2. However, the influence zone limits for most mobility related variables have remained either between 3.5-4.5 km range or between 5-5.5 km range and widening of NH2 has, by and large, not strongly affected the influence zone.

Figure 4: Per capita trip rate for work

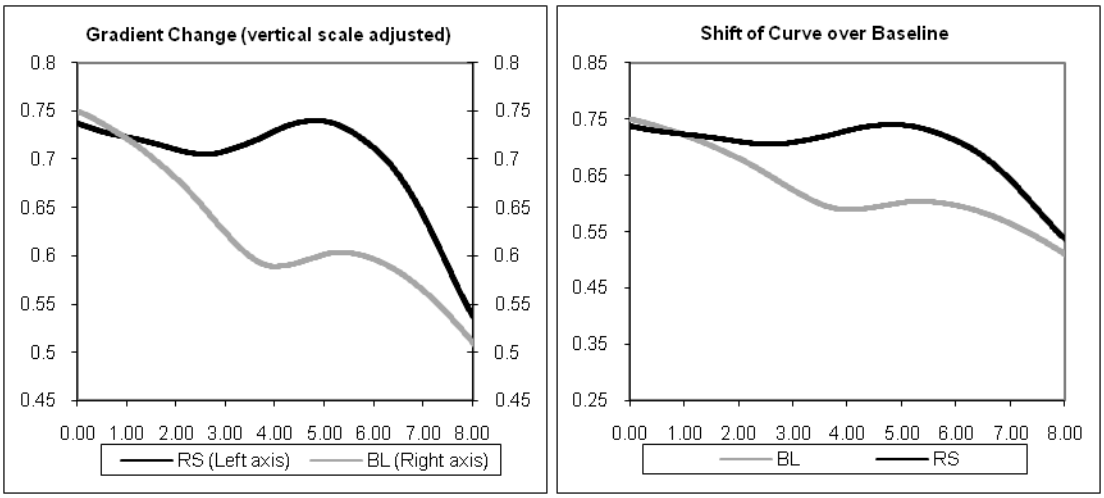


Figure 5: Per capita trip rate for market

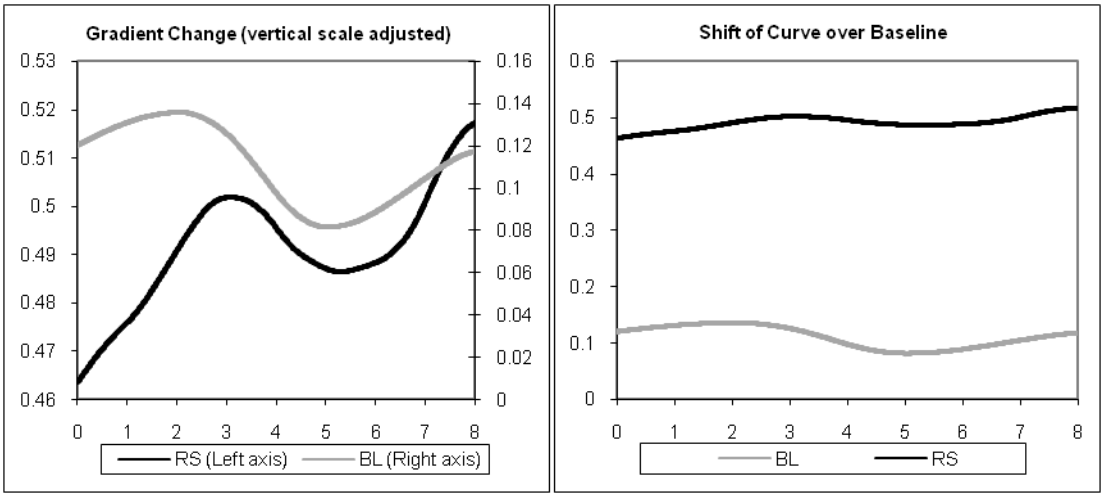


Figure 6: Per capita trip rate for education

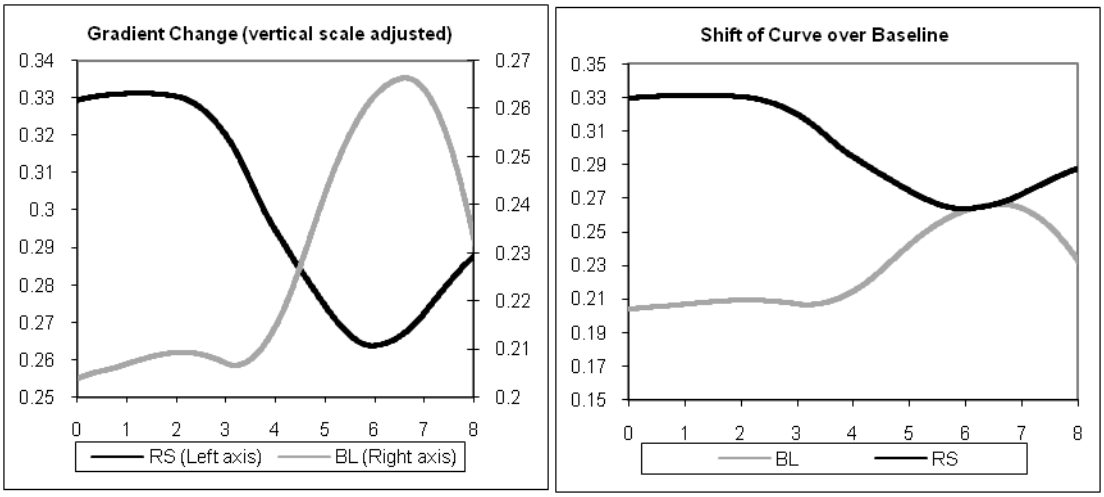


Figure 7: Per capita trip rate for health

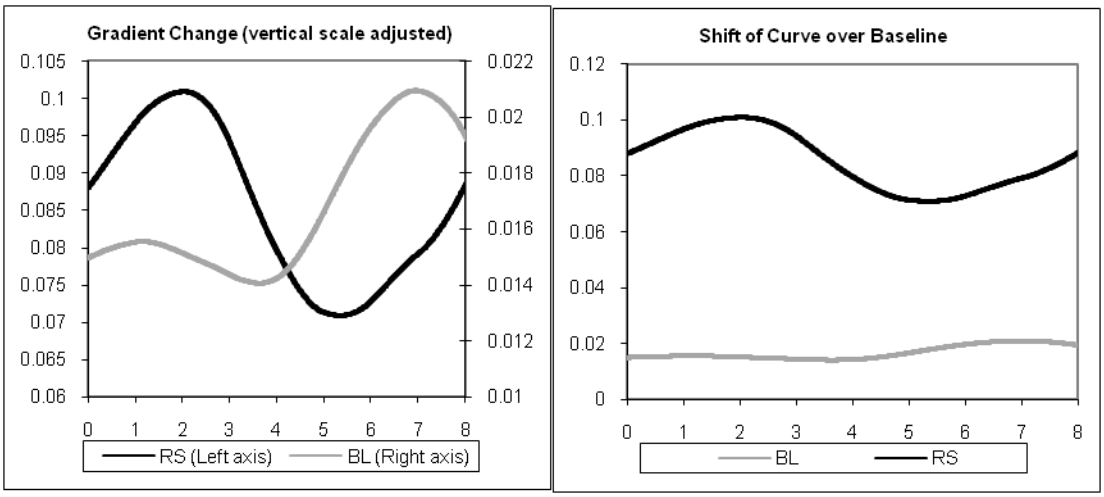


Figure 8: Per capita trip rate on NH

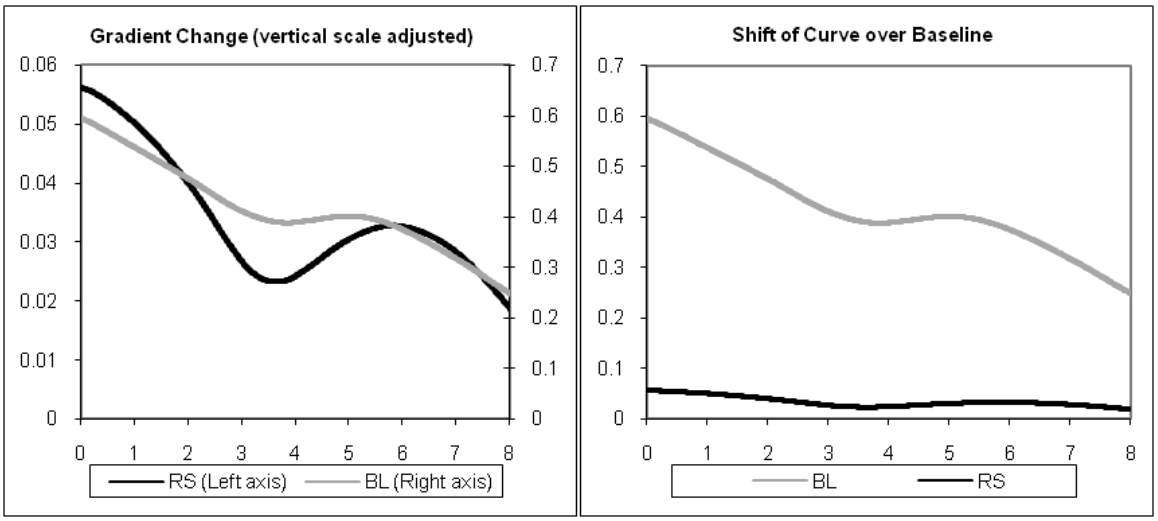


Figure 9: Per capita trip length on NH

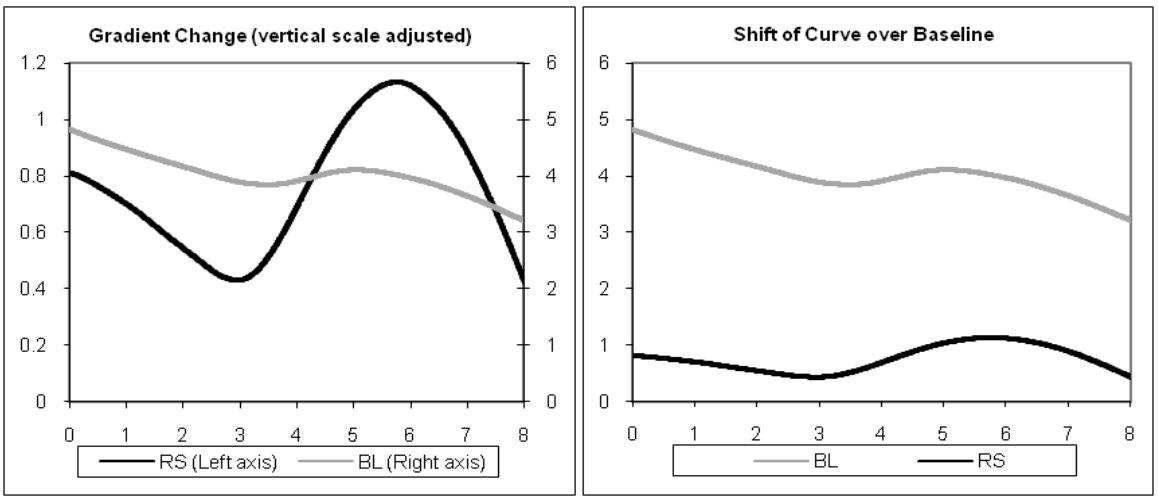


Figure 10: Per capita travel cost on NH

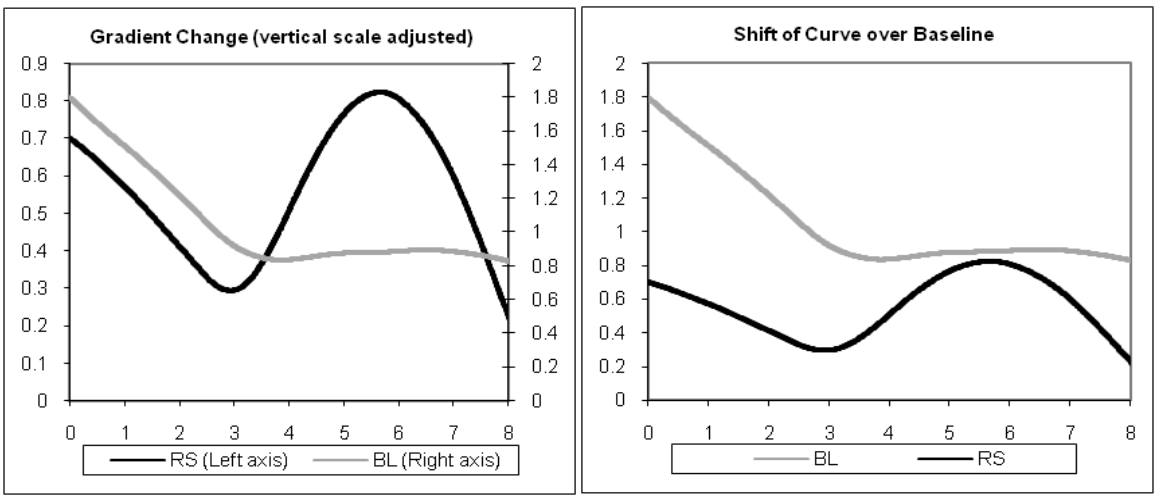


Figure 11: Per capita travel time on NH (minutes)

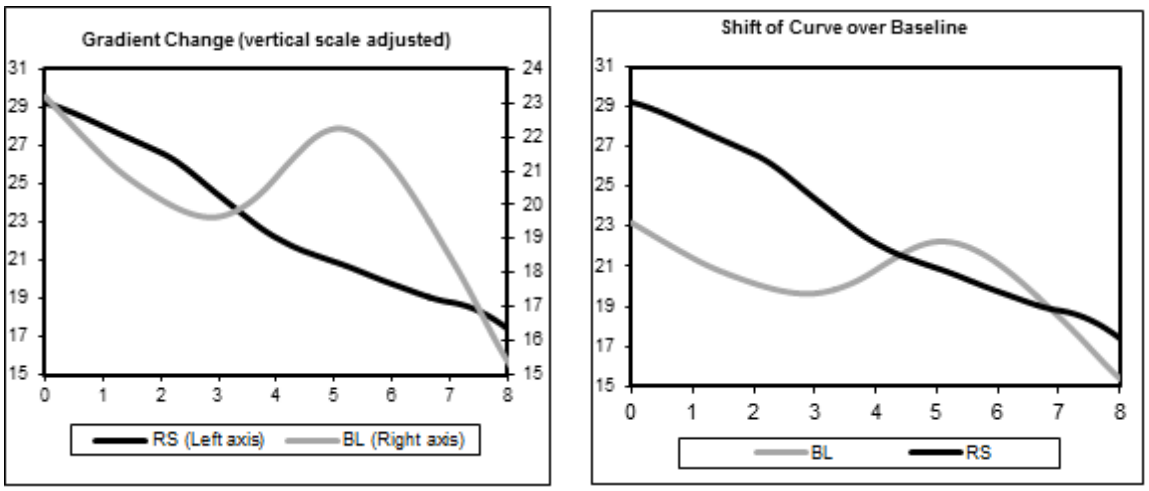
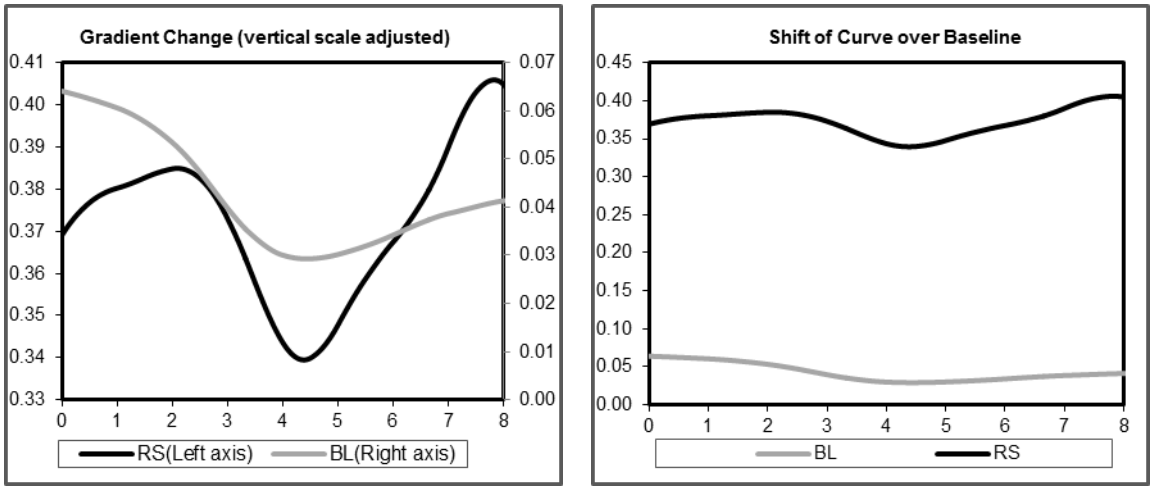


Figure 12: Spending per capita per km on NH (Rs.)



Income, employment and occupation

Proximity to NH2 is likely to promote a structural change towards more remunerative non-agricultural activities in local economies of the neighbourhood. In addition, improved connectivity will enable those living closer to NH2 to find more non-agricultural employment farther away. This implies that income, consumption, share of non-agricultural income in total income, proportion of non-agricultural workers in all workers, etc. would be inversely related with the distance of NH2 and levels of these variables would increase after NH2 upgrading.

Figure 13: Annual per capita income (Rs.)

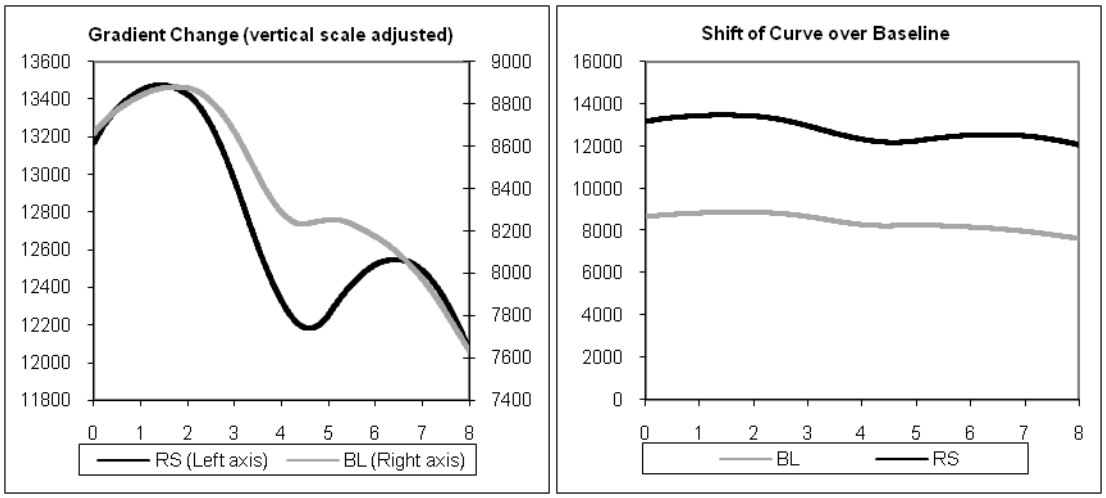
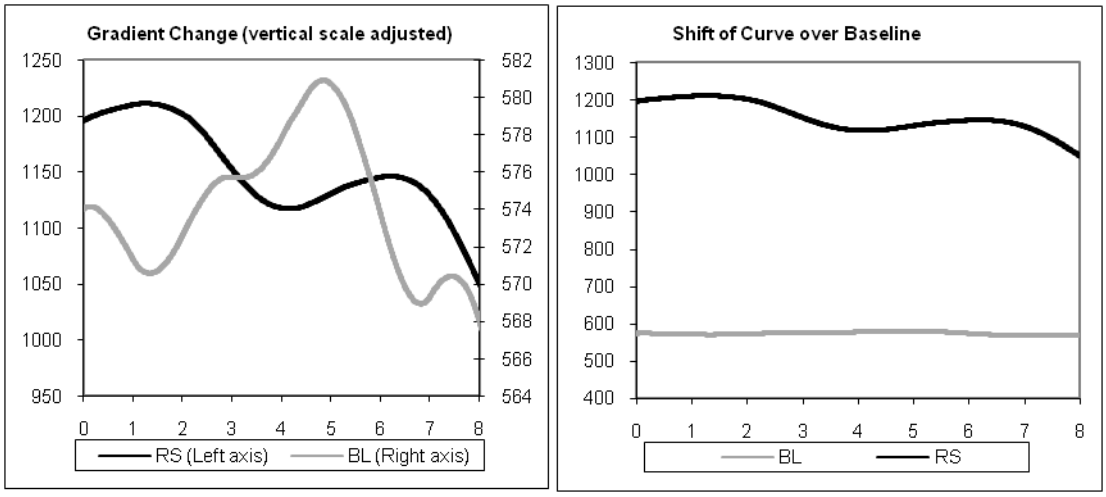


Figure 13, which gives the NPR graph for H13 (annual per capita income), shows broadly the expected inverse relationship with distance from NH2 for both the baseline and resurvey data. In both cases, a change of gradient with the reversal of direction is suggested at around 4.5 km distance. This may be taken as the unchanged limit of the influence zone for this variable. The higher level of the resurvey graph at all distances may be indicative of the positive effect of NH2 upgrading.

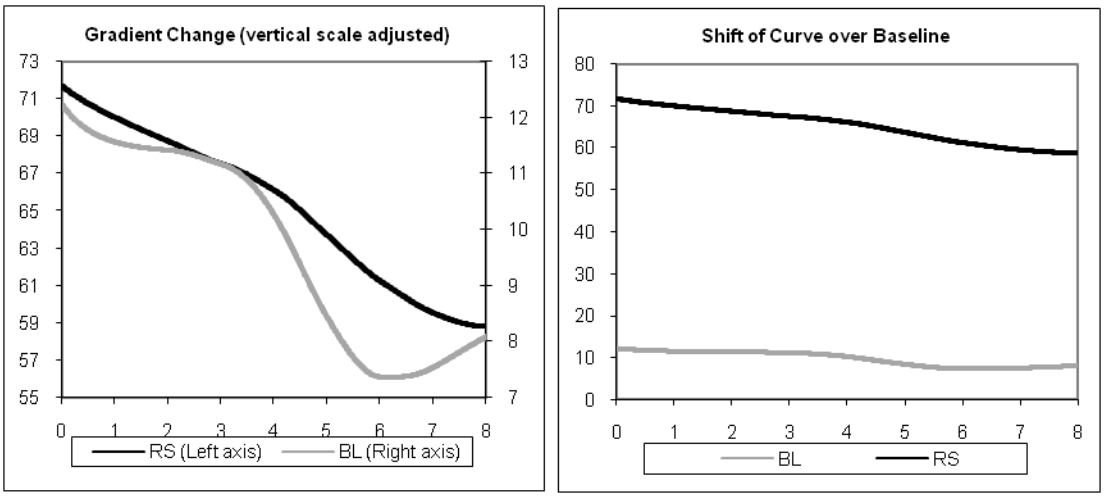
Figure 14: Monthly per capita consumption expenditure (MPCE) (Rs.)



For H14 (MPCE), the baseline and resurvey graphs are of quite different shapes. Whereas the baseline graph shows a rising tendency up to 5 km and then declines sharply, the resurvey graph has a tendency to decline all through, attaining a local minimum around 4 km. Thus, in this case, whereas the baseline graph does not support the expected inverse relationship of MPCE with distance, the resurvey graph

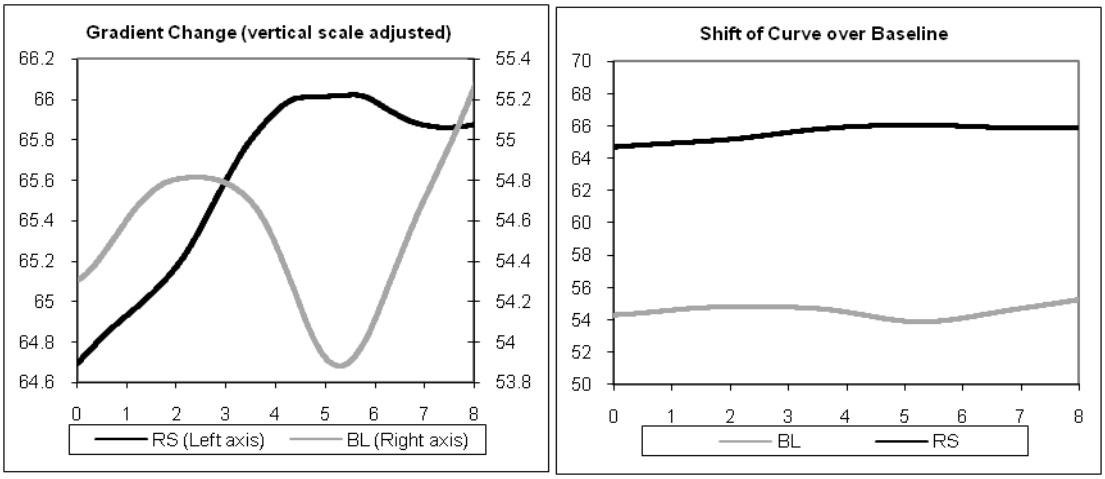
does so and suggests a 4 km influence zone. The higher level of the resurvey graph at all distances may be an indication of the positive effect of NH2 widening.

Figure 15: Share of non-agricultural income in total income



For H15, both the baseline and resurvey graphs show the expected inverse relationship, although the slopes of these graphs are very small. The baseline graph suggests a gradient change at around 6 km distance. The resurvey graph, however, does not have such a gradient change. The influence zone thus may have expanded from 6 km to 8 km between the baseline and resurvey period. The level of the resurvey graph is much above that of the baseline graph and this may denote the positive effect of NH2 upgrading.

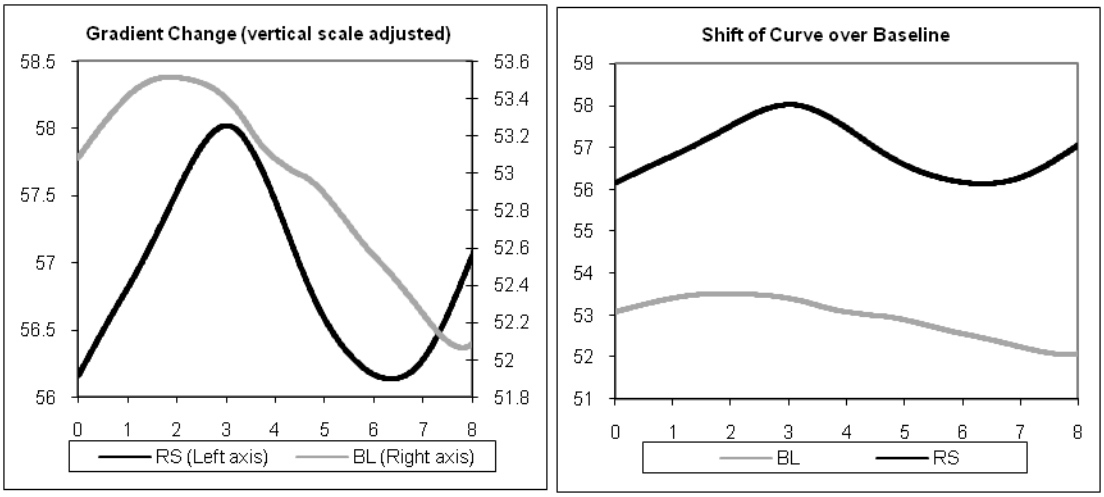
Figure 16: Share of food expenditure in total expenditure



For share of food in MPCE (H16), a positive relationship with distance from NH2 is expected, because share of food in MPCE is inversely related to income (by Engel's law) which, in turn, is expected to be inversely related with distance from

NH2. The shape of the baseline graph is not consistent with *a priori* expectation. The resurvey graph, however, shows a positive relationship. The slopes of the graphs are indeed quite small, possibly indicating that the effect of NH2 would be mild. The resurvey graph shows a larger share of food expenditure at all distance levels and hence a deterioration of level of living between the baseline and the resurvey periods. This is in conflict with the observation of improvement in income level between the baseline and resurvey periods.

Figure 17: Proportion of working members in the age group 15-59



For H17 and H18, NPR graphs are of very similar shapes for both the baseline and resurvey. The gradients of these graphs are small for both variables and so the influence zone is not clearly indicated in these cases by the NPR graphs. A closer look, however, suggests a shrinking of influence zone. Higher level of the resurvey graph may be supportive of the positive effect of NH2 upgrading.

Figure 18: Proportion of female working population in age group 15-59

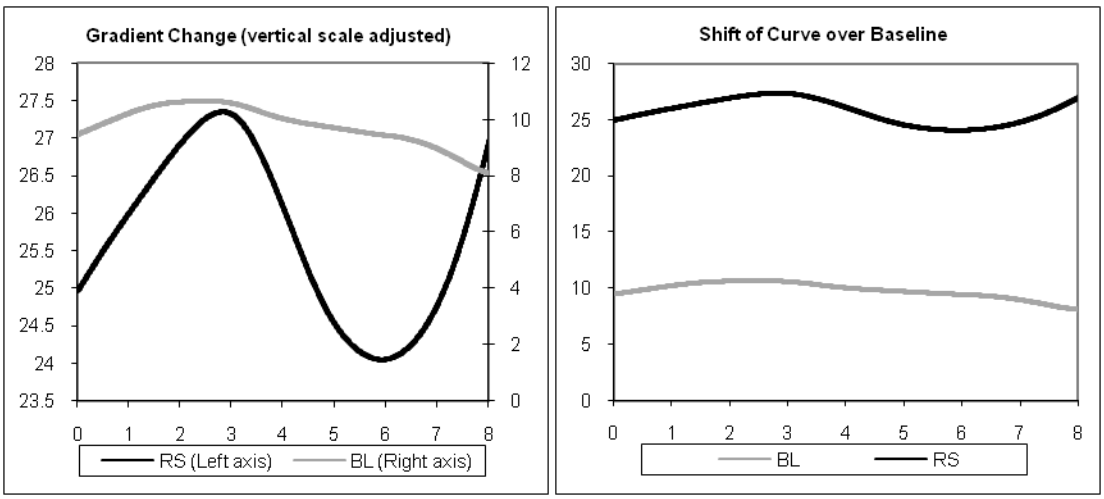
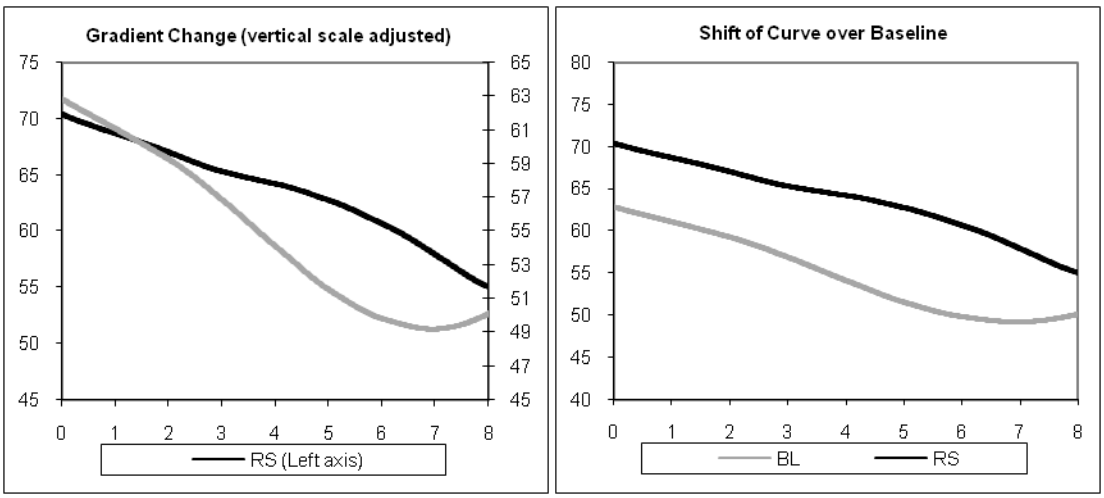


Figure 19: Proportion of non-agricultural workers in total workers



For H19 both the graphs have the expected downward sloping shape over the entire distance range. The baseline graph, however, shows a very mild gradient change around 7 km. The resurvey graph having a higher level, is suggestive of a positive impact of NH2 upgrading.

Assets and ownership

One would expect proximity to NH2 to promote asset acquisition due to income improvement and NH2 widening should strengthen this tendency. For H20 (probability of being landless), however, appreciation of land value due to proximity to and/or upgrading of NH2 may induce land sell out and thus H20 may show an inverse relationship. An inverse relationship with distance from NH2 is also expected for the other two ownership variables, H21 and H22, due to their positive relation with income and mobility.

For H20 baseline and resurvey graphs are very similar and monotonically decreasing. The lower level of the resurvey graph is supportive of positive income effect of NH2 leading to lower landlessness. The graphs for H21 show a u-shape. The baseline graph clearly suggests a 4.5 km influence zone. The resurvey graph, which is much flatter, suggests a 7 km influence zone very weakly. It shows a level about 3 times that of the baseline graph, supporting the positive effect of the NH2 upgrading.

The baseline graph for H22 shows a u-shape. The resurvey graph has a somewhat different shape with influence zone showing a decline in distance. A higher level of the resurvey graph could be interpreted as showing the positive effect of NH2 upgrading.

Figure 20: Proportion of landless households

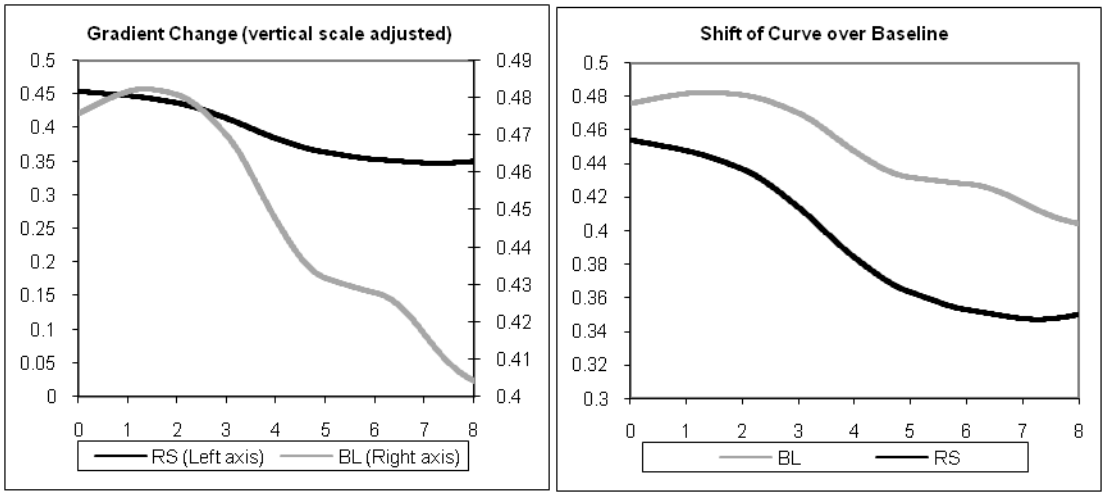


Figure 21: Proportion of households owning at least one consumer durable

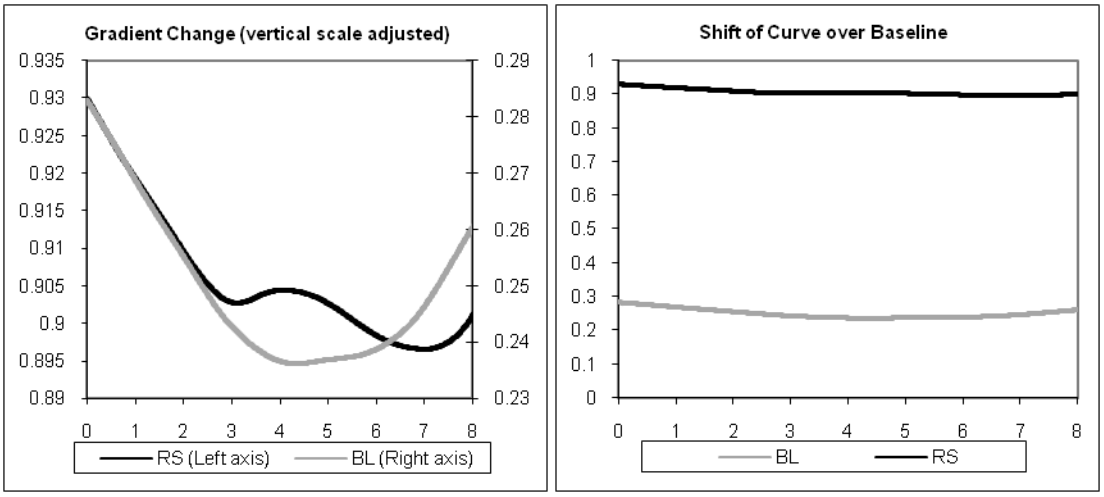
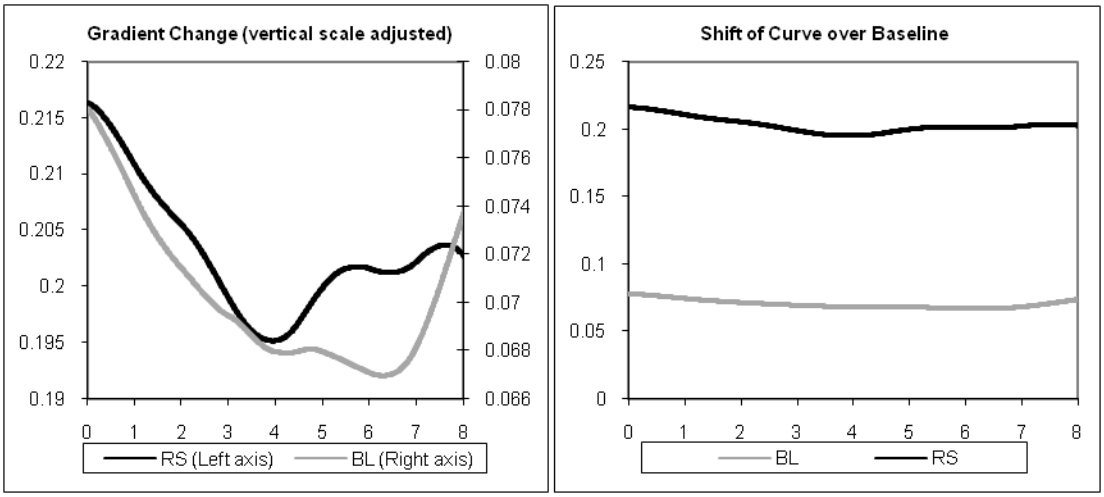


Figure 22: Proportion of households owning at least one motorized vehicle



Education and health

Given the expectation that a road infrastructure development would promote human development, inverse relation of H23 to H25 with NH2 distance is expected and the level of the function should go up with upgrading of NH2. However, since these variables are likely to be affected strongly by direct public policy interventions, shapes of the observed graphs would depend on the pattern of spatial distribution of such direct public interventions.

The baseline and resurvey graphs for H23 and H24 are of somewhat different shapes and they do not readily suggest an influence zone. However, in both cases, the resurvey graph has a higher level. The graphs for both the baseline and resurvey for H25 decline after an initial phase of approximate constancy. The influence zone seems to have expanded marginally from 5.5 km to 6 km. The higher level of the resurvey graph, suggests positive effect of NH2 upgrading.

Figure 23: Proportion of school going children in the age group 6-14 years

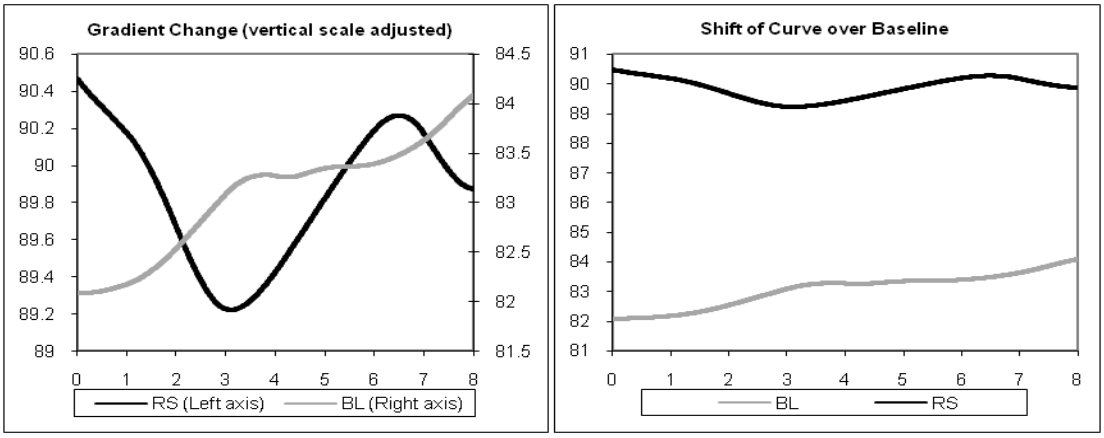


Figure 24: Percentage of female school going children in the age group 6-14 years

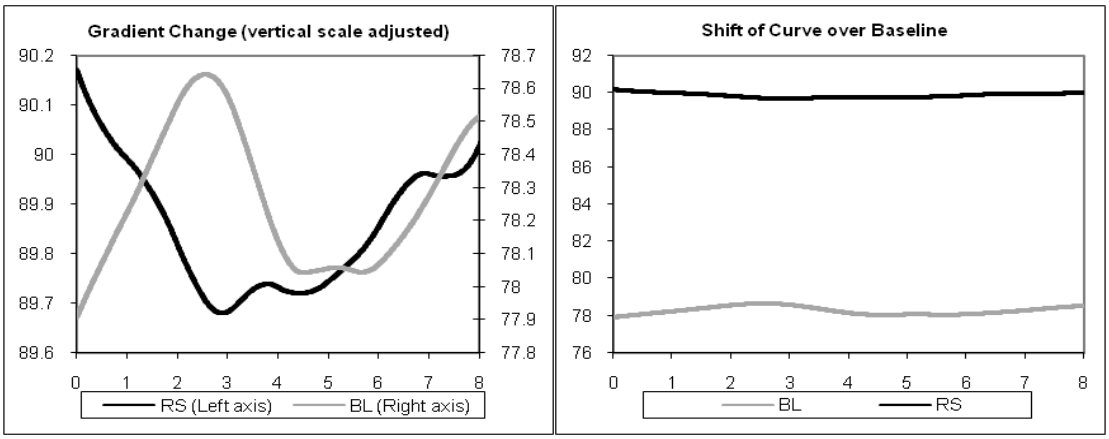
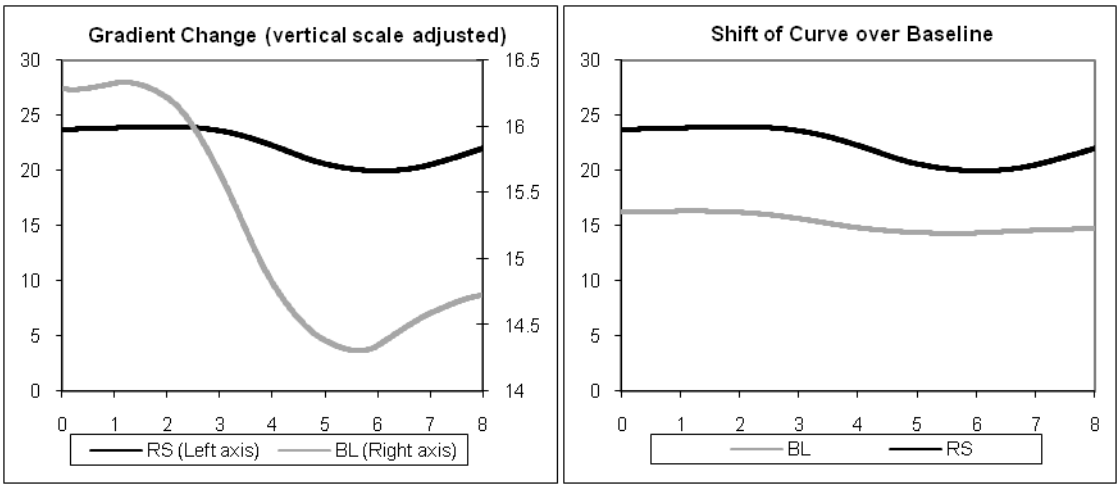


Figure 25: Proportion of household members who availed medical services



Attitudinal response

The shapes of the baseline and resurvey graphs of H26 and H27 do not match the expectation. Since in the case of both of them the baseline and resurvey graphs are of very dissimilar shapes, it is difficult to conclude much from these graphs. In fact, the resurvey graph is declining while the baseline graph is rising, which contradicts expectation.

Figure 26: Proportion of households which rate themselves poor

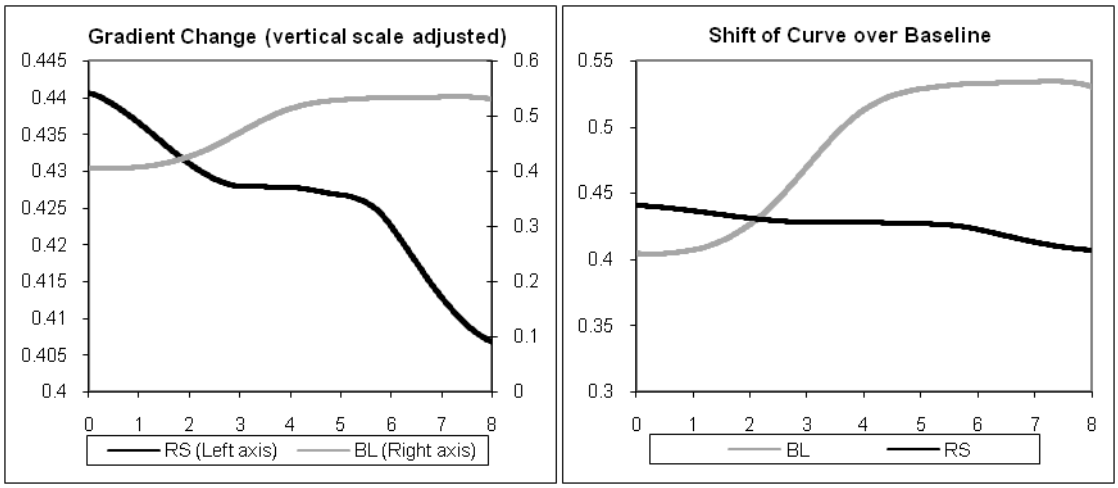
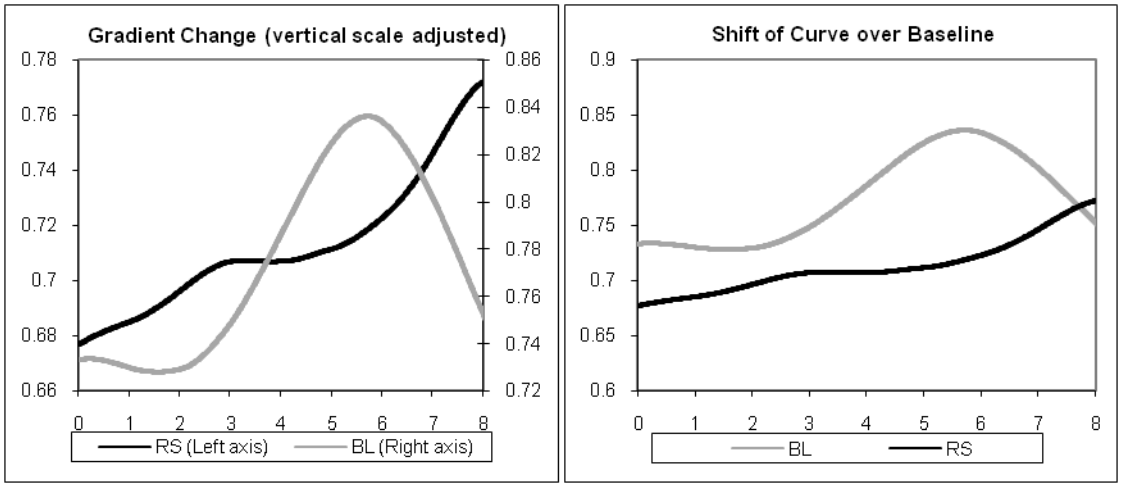


Figure 27: Proportion of household expect improvement in employment



Well-being indices

Finally, the impact of proximity to NH2 has been analyzed in this study for the two well-being indices: (i) index of overall well-being based on income, employment, health and education (H28); and (iii) index of well-being in respect of access to basic amenities like electrical connection, safe drinking water, proper sanitation and type of house (semi-pucca or pucca) (H29). These indices have been constructed to give an indication of overall well-being and show the level of socio-economic development. These indices are the summary measure of well-being and are constructed along the line of UNDP Human Development Index[10].

The household index of overall well-being has been compiled using the household specific data on: (a) per capita expenditure, (b) share of income earned from self-employment in non-agricultural activities, (c) labour participation rate, (d) proportion of family members visiting health personnel, and (e) proportion of school-going children. It may be noted that some of these variables are related to entitlement to well-being [like (a) and (c)], while others relate to capability for well-being [viz., (b), (d) and (e)].

The second well-being index, based on access, has been compiled by combining household specific responses to such qualitative outcome variables as (a) whether the household has electrical connection, (b) whether it is dependent on

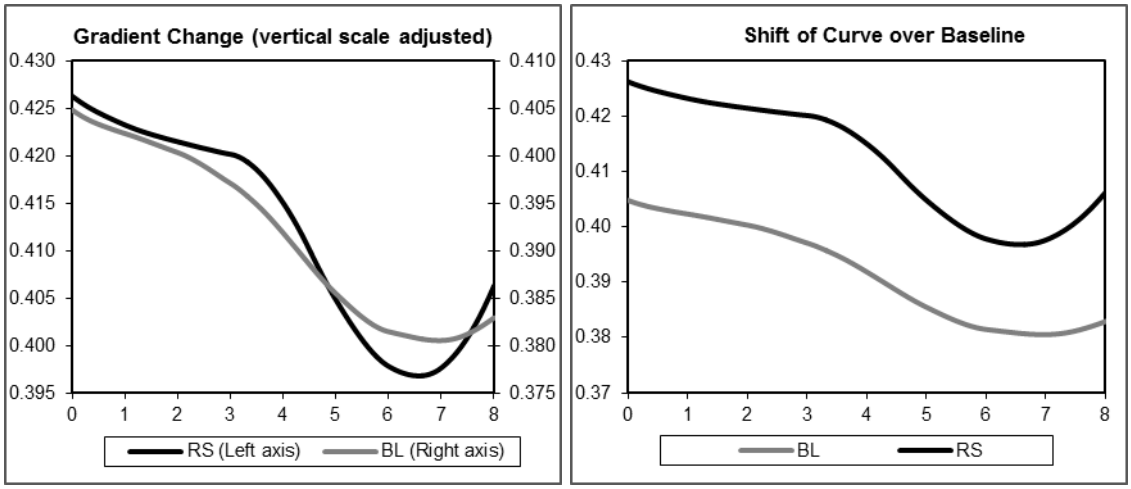
10. See Appendix 1.

biomass for energy, (c) whether it has toilet facilities, (d) whether it has access to drinking water, and (e) whether it has a semi-pucca or pucca house.

The simple correlation analysis shows that the first well-being index and distance from the highway is negatively related and significant for H28 for both the resurvey and baseline, which is consistent with the normal expectation of positive role of proximity to highway on the state of well-being. However, the correlation coefficient between H29 and H0 has turned out to be positive in the resurvey which is contrary to expectation, but it is not statistically significant.

Overall well-being index based on income, employment, health and education (H28): The non-parametric regression curve of H28 on H0 has been found to be declining consistent with a prior expectation for both baseline and resurvey data. The influence zone remains the same for both the surveys and extends upto a distance of 6 Km. More importantly, there has been an upward shift in the curve, showing inter-temporal improvement in well-being.

Figure 28: Overall well-being index based on income, employment, health and education



Index of access to infrastructural facilities, assets and amenities (H29): The simple correlation coefficient between this variable and approach distance H0 has been negative for the baseline survey data but positive and insignificant for the resurvey data. The non-parametric regression graph for this outcome variable as expected declines with increase in approach distance from the highway attaining a minimum at 4.5 km distance for the baseline data. The curve of regression then remains relatively flat. The resurvey, on the other hand, initially declines up to 3.5 km

beyond which it rises till 8 km, the limit of the range for the outcome variable. The limit of influence area of the highway for this variable thus appears to have declined from 4.5 km to 3.5 km. There has been an upward shift of the graph indicating an improvement in the overall access.

Figure 29: Index of access to infrastructural facilities, assets and amenities

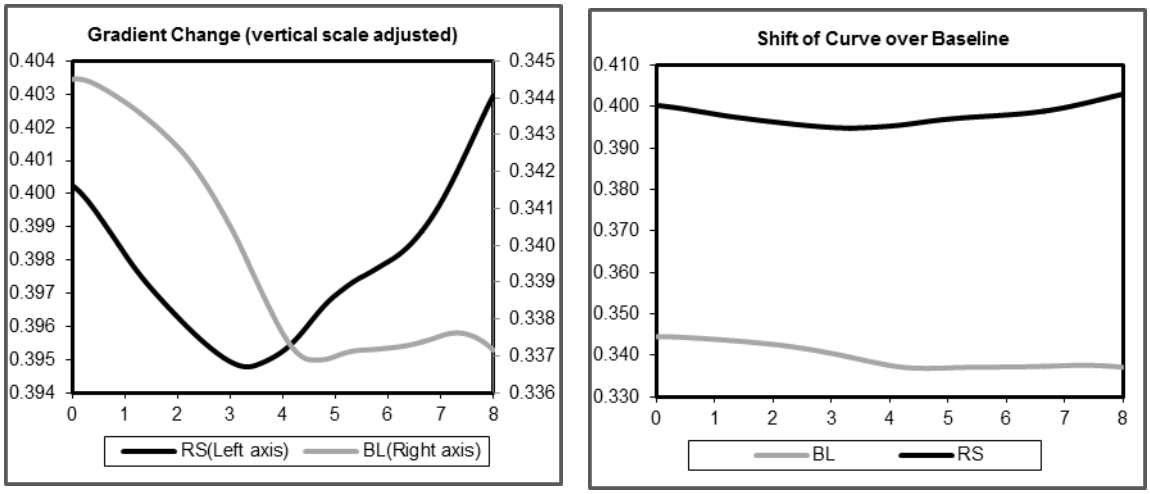


Table 5 gives a summary of the NRA results and the graphs of estimated non-parametric regression functions relating individual outcome variables to distance from NH2 (H0). It gives a qualitative summary of the shape of the non-parametric regression function and its change, if any, after upgrading of NH2 for individual outcome variables, based on baseline and resurvey results of NRA. On the whole, these NRA results seem to support the gradient of change hypothesis for most of the outcome variables (except for H16, H23, H24, H26 and H27 for both baseline and resurvey and for H6 and H14 for only baseline) and the non-parametric regression curves show systematic relationships of outcome variables with distance from NH2.

Table 5: Curves of non-parametric regression and influence zone limit

	Variable	Curve of non-parametric regression		Influence zone limit (Approach distance in km)		Shift of NP regression graph: resurvey vs. baseline
		Baseline	Resurvey	Baseline	Resurvey	
Incidence of poverty						
H1	Proportion of poor households based on poverty line measured in terms of MPCY	Rises upto 4 km followed by decline upto 5.5 km and finally rises thereafter	Rises upto 3 km followed by steady decline upto 7 km and rises thereafter	4	3	Downward
H2	Proportion of poor households based on poverty line measured in terms of MPCE	A mild rise upto 3.5 km followed by a decline upto 5.5 km and rises thereafter	Rises upto 3.5 km followed by a decline upto 7 km and rises thereafter	5.5	7	Downward
Mobility						
H3	Per capita trip rate (PCTR)	Decline upto 4 km followed by a rise upto 7 km and a fall thereafter	More or less stationary upto 5 Km and a decline thereafter	4	8	Upward
H4	Per capita trip rate for work	Declines upto 4 km followed by a mild rise upto 5.5 km followed by decline	Approximately stationary upo 5 Km and decline thereafter	4	8	Upward
H5	Per capita trip rate for marketing	The graph rises upto 2 km followed by a decline upto 5 km beyond which it rises	Rises upto 3 km followed by a decline upto 5.5 km beyond which it rises	5	5.5	Upward
H6	Per capita trip rate for education	Does not match with a priori expectation regarding gradient of change	Stationary upto 2.5 km and then declines upto 6 km followed by a rise	no pattern	6	Higher values up to 4.5 Km
H7	Per capita trip rate for accessing health-related services	Mildly rises upto 1.5 km followed by a decline upto 4 km beyond which it rises	Rises initially upto 2 km followed by a decline upto 5.5 km after which it rises	4	5.5	Upward
H8	Per capita trip rate involving travel on NH2	Declines upto 3.5 km followed by a mild rise reaching a maximum upto 5 km beyond which it declines	Declines upto 3.5 km followed by a rise upto 6 km beyond which it declines	3.5	3.5	Upward
H9	Per capita trip length for trips involving travel on NH2	Declines upto 3.5 km followed by mild rise upto 5 km and beyond which it mildly declines	Declines upto 3 km followed by a rise upto 6 km beyond which it declines	3.5	3	Downward
H10	Per capita travel expenses for trips involving travel on NH2	Declines upto 3.5 km followed by mild rise upto 5 km and beyond which it mildly declines	Declines upto 3 km followed by a rise upto 6 km beyond which it declines	3.5	3	Downward
H11	Per capita travel time for trips involving travel on NH2	Declines upto 3 km followed by a rise upto 5 km beyond which it declines	Declines throughout upto 8 km	3	8	Higher values up to 4 Km
H12	Travel cost per person km for trips involving travel on NH2	Declines upto 4.5 km followed by a rise	Rises upto 2.5 km followed by a decline upto 4.5 km beyond which it rises	4.5	4.5	Upward
Income, employment and occupation						
H13	Per capita income (annual)					
	Deflated Per capita income (annual)	Rises initially upto 2 km followed by decline upto 4.5 km followed by a mild rise upto 5.5 km beyond which it declines	Rises upto 1.5 km followed by a decline upto 4.5 km beyond which it rises upto 6.5 km followed by a decline	4.5	4.5	Upward
H14	Per capita consumption expenditure (monthly)					
	Deflated Per capita consumption expenditure (monthly)	Shape not consistent with a priori expectation	Mild rise upto 1.5 Km followed by a decline upto 4 Km beyond which it rises upto 6.5 Km beyond which it declines	no pattern as per a priori expectation	4	Upward
H15	Share of income from self-employment in non-agricultural activities	Declines upto 6 km	Declines throughout upto 8.5 Km	6	8	Upward
H16	Share of food in consumption expenditure	Shape not consistent with a priori expectation	Shape not consistent with a priori expectation	no pattern as per a priori expectation	no pattern as per a priori expectation	Upward
H17	Proportion of working members in a household in age group 15-59 years	Rises mildly upto 2 km followed by a decline upto 7.5 km beyond which it rises	Rises upto 3 km followed by a decline upto 6.5 km beyond which it rises	7.5	6.5	Upward
H18	Proportion of working female members in a household in age group 15-59 years	Rises upto 2.5 km followed by a decline	Rises upto 3 km followed by a decline upto 6 km beyond which it rises	8.5	6	Upward
H19	Proportion of non-agricultural workers in total working household members.	Declines upto 7 beyond which it rises	Declines throughout upto 8 km	7	8	Upward

	Variable	Curve of non-parametric regression		Influence zone limit (Approach distance in km)		Shift of NP regression graph: resurvey vs. baseline
		Baseline	Resurvey	Baseline	Resurvey	
Asset ownership						
H20	Proportion of landless households	Rises upto 2.2 km beyond which it declines throughout	Declines upto 7.5 km beyond which it rises	8	7	Marginally lower
H21	Proportion of households owning at least one information related consumer durable	Declines upto 4.5 km followed by a rise	Declines upto 7 km followed by a rise	4.5	7	Upward
H22	Proportion of households owning at least one motorised transport vehicle	Declines upto 6.5 km followed by a rise	Declines upto 4 km followed by rise of the curve upto 7.5 km beyond which it declines	6.5	4	Upward
Education and health						
H23	Proportion of school-going children among all children in age group 6-14 years	Not consistent with a priori expectation and difficulty in conclusion	Not consistent with a priori expectation and difficulty in conclusion	dissimilar shape, no conclusion	dissimilar shape, no conclusion	Upward
H24	Proportion of female school-going children among all female children in age group 6-14 years	Not consistent with a priori expectation and difficulty in conclusion	Not consistent with a priori expectation and difficulty in conclusion	dissimilar shape, no conclusion	dissimilar shape, no conclusion	Upward
H25	Proportion of household members who availed of medical facilities during last six months	Stationary upto 1.5 km followed by a decline upto 5.5 km beyond which it rises	Mildly rises upto 2.5 km followed by a decline upto 6 km beyond which it rises	5.5	6	Upward
Attitudinal response						
H26	Proportion of households who rate themselves poor or very poor	Not consistent with a priori expectation and difficulty in conclusion	Not consistent with a priori expectation and difficulty in conclusion	Difficulty in interpretation	Difficulty in interpretation	Inconclusive
H27	Proportion of households who expect improvement in employment situation after 4-laning of NH2	Not consistent with a priori expectation and difficulty in conclusion	Not consistent with a priori expectation and difficulty in conclusion	Difficulty in interpretation	Difficulty in interpretation	Inconclusive
Well-being index						
H28	Index of overall well-being based on income, employment, health and education	Declines upto 7 km followed by a rise	Declines upto 6.5 km followed by a rise	7	6.5	Upward
H29	Index of access to infrastructural facilities, assets and amenities	Declines upto 4.5 km and remains relatively flat thereafter.	Declines upto 3.5 km follow	4.5	3.5	Upward

As regards the shift of the non-parametric regression curves between baseline and resurvey, in almost all the cases, the observed shifts indicate improvement, in some cases substantial improvement, in the level of the outcome variable after upgrading of NH2. However, it should be noted that since the distance from NH2 is only one of the sets of explanatory variables influencing the set of outcome variables, these observed favourable shifts need not be entirely due to the upgrading of NH2.

So far as the expansion of the influence zone of NH2 after its upgrading is concerned, the results are rather mixed. For some variables (viz. H1, H9, H10, H17, H18, H20, H22, H28 and H29), a shrink of the influence zone is indicated. For some others (viz. H2, H3 – H5, H7, H11, H15, H17, H19, H21 and H25), on the other hand, expansion of the influence zone is suggested. It may be noted in this context that if the influence zone gets changed, no matter whether it expands or shrinks, the impact of upgrading would remain somewhat underestimated. This will be so because if the

influence zone expands (shrinks), the resurvey mean value for the specified control (influence) zone will overestimate (underestimate) the true control (influence) zone mean.

PSMT-based impacts – Some recalculations

The NRA results summarized in Table 5 give indication of the possibility that the influence zone of NH2 may have changed after its upgrading. Normally, in the absence of any other intervention due to policy or otherwise, the influence zone may expand, if it changes, and not shrink. The NRA results appear to indicate variable-specific change of the influence zone in either direction, given the gradient change criterion used for the purpose of empirical determination of influence zone delineation. As an illustrative exercise, PSMT-based DDA has been re-done using a 6 km delineation for those 11 outcome variables for which the double difference impact measures reported in Table 4 turned out to be unexpected and counter-intuitive. The results of this exercise are given in Table 6.

Table 6: Impact on outcome variables based on comparison of mean values using propensity score matching of households (6 km limit based influence zone)

	Variable	PSMT-based mean value (Baseline)		Baseline difference between influence zone and control zone (1) - (2)	PSMT-based mean value (Resurvey)		Resurvey difference between influence zone and control zone (4) - (5)	Double difference between influence zone and control zone
		Influence zone	Control zone		Influence zone	Control zone		
		1	2	3	4	5	6	7
Incidence of poverty								
H1	Proportion of poor households based on poverty line measured in terms of MPCY	36.6572	38.6705	-2.0134	30.9289	33.8321	-2.9032	-0.8898
H2	Proportion of poor households based on poverty line measured in terms of MPCE	44.6637	50.1217	-5.4580	41.8136	47.7081	-5.8945	-0.4365
Mobility								
H7	Per capita trip rate for accessing health related services	0.0131	0.0189	-0.0058	0.0575	0.0644	-0.0069	-0.0011
Income, employment and occupation								
H13	Deflated per capita annual income (Rs.)	8151.6456	7884.3683	267.2773	9074.4839	8580.6282	493.8557	226.5784
H14	Deflated per capita monthly consumption expenditure (Rs.)	555.0226	616.9738	-61.9512	780.3302	726.4492	53.8811	115.8323
H17	Proportion of working members in a household in age-group 15-59 years	49.2661	48.6788	0.5873	54.2056	54.2113	-0.0057	-0.5930
Asset ownership								
H21	Proportion of households owning at least one information-related consumer durable	15.8744	16.4964	-0.6220	70.7809	71.1305	-0.3497	0.2723
H22	Proportion of households owning at least one motorised transport vehicle	9.9062	12.8578	-2.9516	25.5324	27.6613	-2.1289	0.8227
Education and health								
H25	Proportion of household members who availed of medical facilities during last six months	13.1431	13.4933	-0.3502	20.3267	20.3948	-0.0681	0.2821
Attitudinal response								
H27	Proportion of households who expect improvement in employment situation after 4-laning of NH2	79.3804	73.6165	5.7638	72.7044	77.4174	-4.7130	-10.4768

It may be noted that except 4 of the 11 outcome variables (viz. H7, H17 and H27), the impact measures are now in line with the expectation. In particular, impact for poverty variables H1 and H2 now works out to be negative, as expected. The lesson of this seems to be that a clinical divide of influence zone-control zone of the relevant population for impact measurement is not possible as explained in Chapter 2.

Summary results

A qualitative summary of the results obtained by using the relevant statistical/econometric techniques for individual outcome variables is given in Table 7 wherein it has been indicated whether the expected beneficial result has been obtained in individual cases. In this table, cases in which the result has matched the expectation are denoted by a tick mark (✓). This summary comparison gives a natural validation of the impact results.

Table 7: Summary results: simple correlation and non-parametric regression analysis of outcome values and distance relationship

	Variable	Correlation analysis	Non parametric regression curve			Comparison of simple means if double difference is positive	Comparison of PSMT means, if double difference is positive
		If of expected sign	If gradient of change with expected sign	If the unit of influence zone has expanded	If the curve has shifted favourably		
	1	2	3	4	5	6	7
Incidence of poverty							
H1	Proportion of poor households based on poverty line measured in terms of MPCY	-	✓	-	✓	-	✓(*)
H2	Proportion of poor households based on poverty line measured in terms of MPCE	-	✓	✓	✓	-	✓(*)
Mobility							
H3	Per capita trip rate (PCTR)	✓	✓	✓	✓	✓	✓
H4	Per capita trip rate for work	✓	✓	✓	✓	-	✓
H5	Per capita trip rate for market	✓	✓	✓	✓	-	-
H6	Per capita trip rate for education	-	-	-	✓	✓	✓
H7	Per capita trip rate for accessing health related services	-	✓	✓	✓	-	-
H8	Per capita trip rate involving travel on NH2	✓	✓	-	✓	✓	✓
H9	Per capita trip length for trips involving travel on NH2	✓	✓	-	-	✓	✓
H10	Per capita travel expenses for trips involving travel on NH2	✓	✓	-	-	✓	-
H11	Per capita travel time for trips involving travel on NH2	✓	✓	✓	✓	✓	✓
H12	Travel cost per person km for trips involving travel on NH2	-	✓	-	✓	✓	✓
Income, employment and occupation							
H13	Per capita annual income	✓	-	-	✓	-	
	Deflated per capita annual income						✓(*)
H14	Per capita consumption expenditure (monthly)	-	-	-	✓	✓	-
	Deflated per capita monthly consumption expenditure						✓(*)
H15	Share of income from self-employment in non-agricultural activities	✓	✓	✓	✓	✓	✓

	Variable	Correlation analysis	Non parametric regression curve			Comparison of simple means if double difference is positive	Comparison of PSMT means, if double difference is positive
		If of expected sign	If gradient of change with expected sign	If the unit of influence zone has expanded	If the curve has shifted favourably		
	1	2	3	4	5	6	7
H16	Share of food in consumption expenditure	-	-	-	✓	✓	-
H17	Proportion of working members in a household in age-group 15-59 years	-	✓	-	✓	-	-
H18	Proportion of working female members in a household in age-group 15-59 years	-	✓	-	✓	✓	✓
H19	Proportion of non-agricultural workers in total working household members	✓	✓	✓	✓	✓	✓
Asset ownership							
H20	Proportion of landless households	✓	-	-	-	-	-
H21	Proportion of households owning at least one information-related consumer durable	✓	✓	✓	✓	-	✓(*)
H22	Proportion of households owning at least one motorised transport vehicle	-	✓	-	✓	-	✓(*)
Education and health							
H23	Proportion of school-going children among all children in age-group 6-14 years	-	-	-	✓	✓	✓
H24	Proportion of female school-going children among all female children in age-group 6-14 years	-	-	-	✓	✓	✓
H25	Proportion of household members who availed of medical facilities during last six months	✓	✓	✓	✓	✓	✓(*)
Attitudinal response							
H26	Proportion of households who rate themselves poor or very poor	-	-	-	-	-	-
H27	Proportion of households who expect improvement in employment situation after 4-laning of NH2	-	✓	-	-	-	-
Well-Being index							
H28	Index of overall well-being based on income, employment, health and education	✓	✓	-	✓	✓	✓
H29	Index of access to infrastructural facilities, assets and amenities	-	✓	-	✓	-	-

Note: In the cases marked by (*) in the last column, the re-computed measures based on 6 km influence zone delineation turned out to be in line with expectation.

The summary of results clearly suggests that proximity to NH2 has a significant relationship with (i) transport and mobility (per capita trip rate, per capita trip rate for work, per capita trip rate involving travel on NH2, per capita trip length for trips involving NH2, per capita travel time for trips involving NH2, travel cost per person km for trips involving NH2), (ii) extent of income and employment in non-farm activities (share of income from self-employment in non-agricultural activities, female labour participation, proportion of non-agricultural workers in total working household members), (iii) asset holding (whether a household owns at least one information related consumer durable), and (iv) health attainment (proportion of household members who availed of medical facilities during the last six months).

As regards the effect on the incidence of poverty, the same has declined in both the influence and control zones, but the magnitude of reduction has been higher in the control zone as compared to influence zone. However, the re-estimation of the net effect based on expansion of the influence zone gave expected positive results.

Concluding observations

Proximity to NH2 and its upgrading has significant beneficial influence on many aspects of household well-being especially those relating to mobility and non-agricultural employment, thereby signalling significant structural changes taking place in the local economies of the neighbourhood of the highway.

The beneficial influence systematically declines as the distance from the highway increases, thus empirically supporting the gradient change hypothesis. The influence zone generally extends up to a distance of 4-5 km on either side of the highway. There are, however, some evidences of the expansion of the influence zone beyond this distance slab.

Post-upgrading shifts of the NPR curves have mostly been in the expected direction. This, however, is only suggestive of the positive impact of NH2, as NPR analysis brings out the total temporal shift of the relationship of an outcome variable with distance from NH2 rather than the partial shift due to upgrading.

The measured impact of NH2 upgrading based on PSMT-based double differences is in the expected direction for majority of the outcome variables, including those for which re-estimation based on 6 km delineation of influence zone gave expected results.

The presumption of temporal fixity of the delineated influence zone required for impact measurement based on double difference needs careful attention. It is, however, realized that a clinical divide of influence zone-control zone for impact assessment is not possible.

Appendix 1

Note on Index Calculation

Well-being index 1

This index of overall well-being is based on income, employment, health and education. Each component is given equal weight. For every household, each component of the Index is calculated as follows:

$$\frac{\text{actual value} - \text{minimum value}}{\text{maximum value} - \text{minimum value}}$$

The maximum and minimum values are called as goal post values. The maximum and minimum goal post values for the components of first index are:

Components	Maximum goalpost value	Minimum goalpost value
Monthly per capita expenditure (Rs.)	10000	0
Share of income earned from self-employment in non-agricultural activities (%)	100	0
Labour participation rate (%)	100	0
Proportion of family members visiting health personnel (%)	100	0
Proportion of school-going children (%)	100	0

Well-being index 2

The second index is calculated using the probability of the household having access to a given facility based on different characteristics. We run a binary logistic regression with access to a given facility as a dependent variable and the independent variables are household size, total income, per capita trip rate, share of working population in total population and land holding. The outcome values are used to calculate dimensions using the following method:

$$\frac{\text{actual value} - \text{minimum value}}{\text{maximum value} - \text{minimum value}}$$

Here the maximum values and minimum values are 0 and 1, respectively. These values are then aggregated using equal weights.

Chapter 6

Status of Rural Access and Mobility

Accessibility and mobility are two fundamental aspects of rural road transport. Accessibility implies ease of access to destinations. Mobility refers to a person's ability to travel. Both these aspects have a relationship of reciprocity. Both of them have been analysed in depth in relation to 200 villages and 3200 households comprising the universe of the present study.

Concepts of Accessibility and Mobility

The definitions of accessibility and mobility have changed over time and are often interchangeably used. Mobility is often defined as the amount of travel people undertake. Accessibility refers to the ability to reach desired goods, services, activities and destinations. This perspective considers all access options as potentially important, including motorized and non-motorized modes. It values modes according to their ability to meet users' needs, and does not necessarily favour longer trips or faster modes if shorter trips and slower modes provide adequate access. An important point is the impact of accessibility on equity. The quality of a person's or a group's access determines their opportunity to engage in economic and social activities. Policies that favour access for one group over others can be considered horizontally inequitable.

The analysis covers the status of access from the national highway to the villages, in particular, the type and nature of this access. It also covers the ownership pattern of vehicles at the village level and the availability of public transport facilities at these habitations. The access of the rural population to social infrastructure such as schools, primary health centres, markets, etc. has also been examined. The issues of mobility of rural households covering aspects like number of trips performed, travel time, trip length, etc. have been analyzed extensively.

The thrust of the analysis is to correlate the pattern of travel behaviour in relation to distance from the highway.It may be mentioned that rural road transport and travel-related issues have also been discussed in two other chapters of this report. For example,

the issues relating to the mobility of the poor and disadvantaged population have been dealt with in Chapter 3, while the relationship between mobility and defined well-being indicators has been examined in Chapter 5.

Connectivity status

The quality of roads connecting the villages to the national highway has an important bearing on the optimal use of the highway by the rural population. Figure 1 shows the status of the roads at the aggregate level connecting all the 200 surveyed villages. The quality of roads has improved over time. At present, 84 percent of the villages have a metalled road access to the highway.

Figure 1: Distribution of villages by type of roads connecting the highway

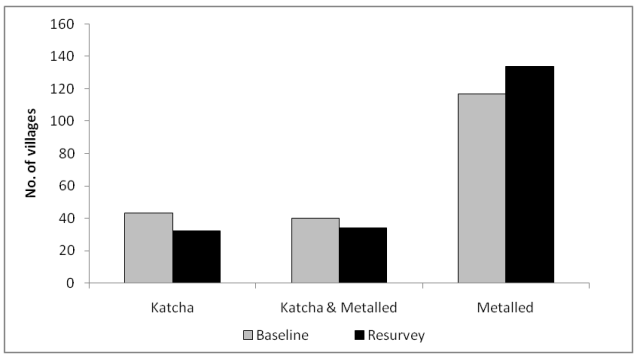


Table 1 shows the type of road connectivity in the stretches falling in the states of Uttar Pradesh, Bihar and Jharkhand. The quality of connectivity is better in Uttar Pradesh as compared to Bihar and Jharkhand. 97 per cent of villages in Uttar Pradesh are connected to the highway with at least one metalled road.

Table 1: Type of road connectivity at state level (resurvey)

State	No. of villages	Type of road		
		Katcha	Katcha & metalled	Metalled
Uttar Pradesh	124	4	9	111
Bihar & Jharkhand	76	28	24	24
Overall	200	32	33	135

Table 2 shows the state-wise position in respect of the category[1] of road connectivity. As many as 54 villages accounting for 25 percent of the total villages are connected with state highways and district roads. This category of roads, therefore, plays an important role in serving the rural population.

Table 2: Category of road connectivity at state level (resurvey)

State	No. of villages	Category of road		
		Village roads	State highways & district roads	Village, district roads & state highways
Uttar Pradesh	124	85	36	3
Bihar & Jharkhand	76	53	18	5
Overall	200	138	54	8

1. In India, the roads are categorized as Village roads, District roads, State highways, National highways.

Vehicle ownership

The rural population own a large variety of vehicles, both motorized and non-motorized. With the passage of time, the share of motorized vehicles has been increasing. Table 3 shows the type and number of vehicles owned at the village level. The average ownership per village works out to 197 vehicles. Bicycles account for 76 percent share. This share was 87 percent at the time of the baseline survey. The share of motorized vehicles has almost doubled from 8.6 percent to 16 percent. Among the motorized vehicles, two-wheelers (motorcycles and scooters) account for a larger share.

Table 3: Type, number and percentage composition of vehicles

Type of vehicles	Baseline		Resurvey	
	Number	Percentage composition	Number	Percentage composition
Cycle	33180	87.31	29936	76.08
Cycle rickshaw	227	0.6	1389	3.53
Bullock cart	1061	2.79	1594	4.05
Horse/Camel/Mule cart	128	0.33	134	0.34
Motorcycle	1179	3.1	3921	9.97
Scooter	655	1.72	552	1.4
Three-wheeler	66	0.17	236	0.6
Car/Jeep	250	0.66	295	0.75
Tractor	914	2.41	1085	2.76
Truck	114	0.3	129	0.33
Bus/Minibus	19	0.05	52	0.13
Tempo	32	0.08	8	0.02
Maruta (hybrid vehicle)	25	0.07	16	0.04
Other	153	0.4	0	0
Total	38003	100	39347	100

The distribution of the share of all types of vehicles and in particular that of motorized vehicles in the distance range of 0-7 km from the national highway is shown in Figures 2(a) and 2(b). The overall vehicle ownership in close proximity of the highway (0-1 km) has substantially declined. However, the ownership of motorized vehicles has gone up.

Figure 2(a): Distribution of share of vehicles by distance from NH2

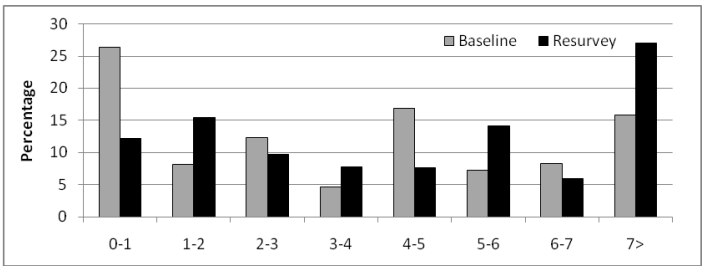
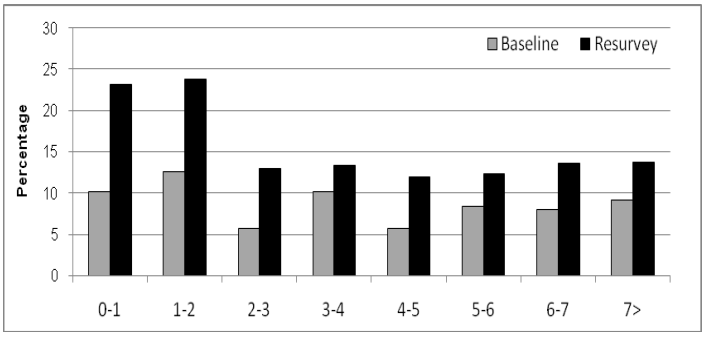


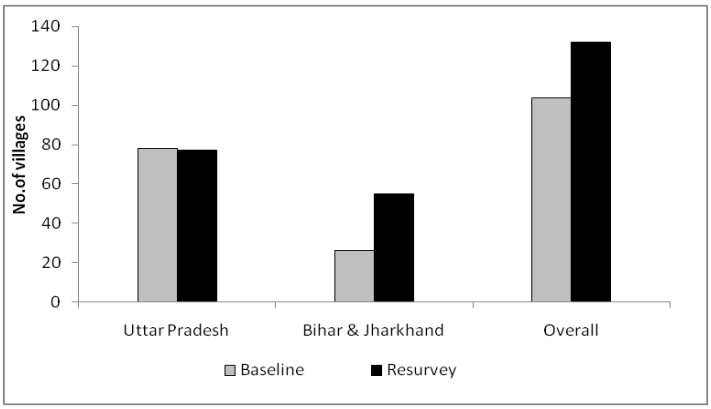
Table 2(b): Distribution of share of motorized vehicles by distance from NH2



Public transport facilities

Figure 3 shows the number of villages having access to public transport. This number has increased significantly since the baseline survey. At present, 66 percent of the villages are served by public transport. The position in the states of Bihar and Jharkhand has considerably improved in this regard.

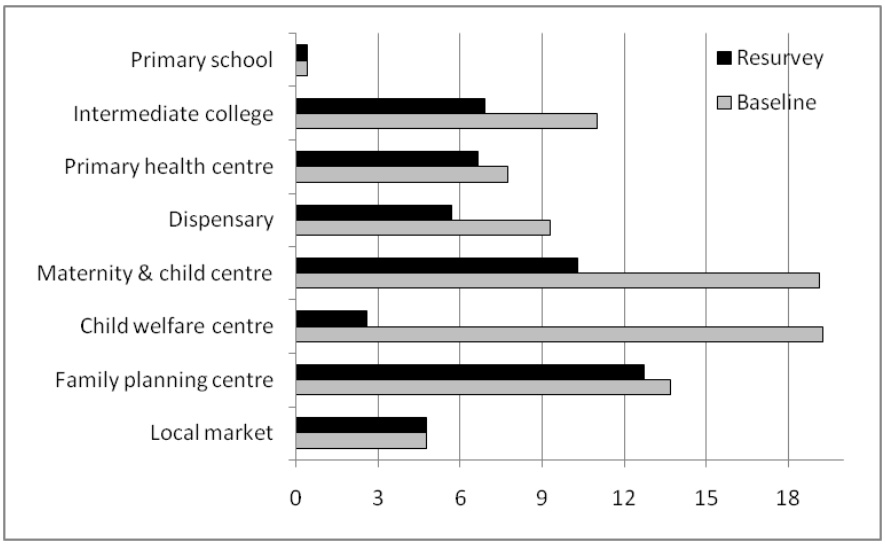
Figure 3: Distribution of villages by availability of public transport facilities



Approach distance to various social infrastructure

The ease of accessibility to social infrastructure is an important aspect of beneficial development. Figure 4 shows average approach distance from villages to various facilities such as primary school, health centre, local market, etc. Over time, these basic facilities are getting located closer to the villages, a clear indication of ease of accessibility to primary social infrastructure.

Figure 4: Average approach distance of villages to social infrastructure



Mobility status

The characteristics of mobility of rural households have been studied in detail. As discussed earlier, mobility is generally measured in terms of the number of trips made per unit of time and is directly related to the purpose of travel. In this study, a 'trip' has been defined as a one-way movement of a person outside the village by any mode of transport for a specific purpose.

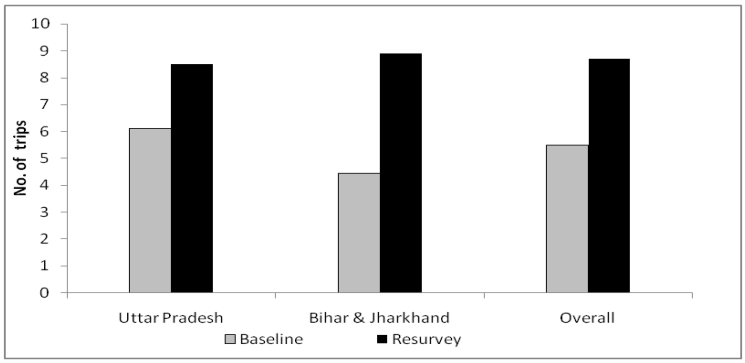
The trip has origin in the village and destination outside the village. Intra-village trips have not been taken into account, since the rural population make frequent short-distance trips within the village, which have little consequence in the assessment of the impact of the national highway. The analysis has been divided into two parts: the first part deals with the defined parameters of mobility, and the second part considers the role of the national highway in rural mobility.

Parameters of mobility

Trip rate

Figure 5 shows the average number of trips undertaken by a household on a weekly basis. There has been significant increase in this number from 5.49 to 8.7. This increase suggests greater access to socio-economic opportunities.

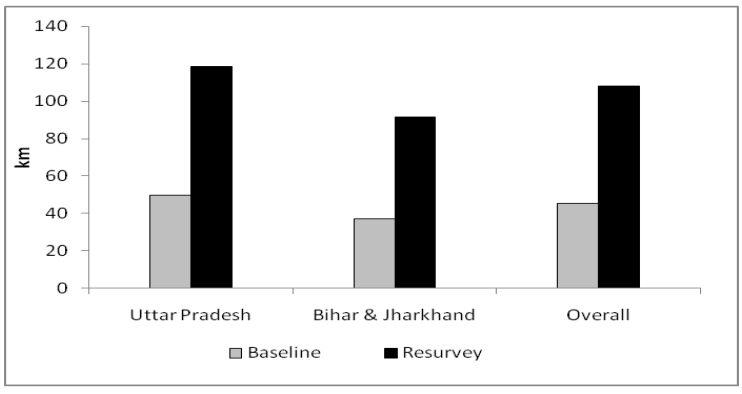
Figure 5: Weekly per household trip rate



Distance travelled and Travel time

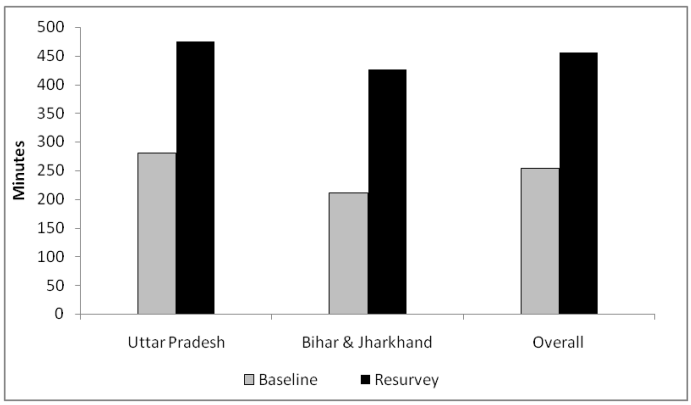
Figures 6(a) and 6(b) show the average distance travelled by a household and the average travel time spent on a weekly basis. There has been more than two-fold

Figure 6(a): Average weekly distance travelled (km) per household



increase in the average distance travelled with corresponding increase in the travel time spent. The increase in the travel distance suggests better spread of socio-economic opportunities.

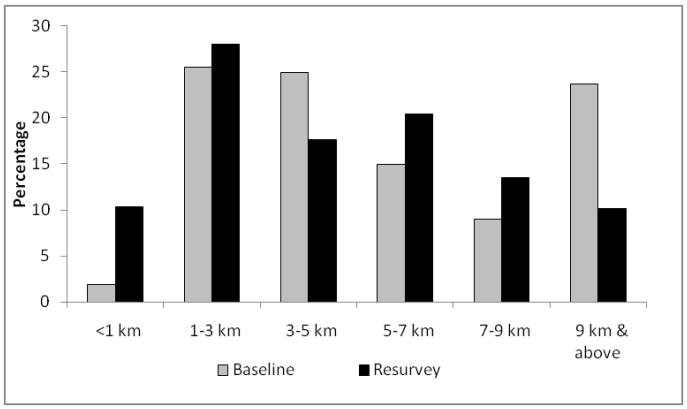
Figure 6(b): Average weekly travel time (minutes) per household



Trip length

The length of most of the trips is relatively short. Figure 7 shows that more than half of the total trips are limited to a distance of 5 km. This shows that the needed facilities are available within this distance slab. There has also been a decline in the number of trips undertaken beyond the distance of 9 km.

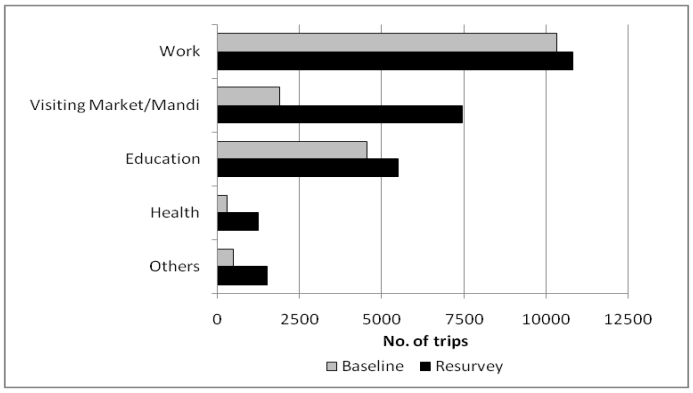
Figure 7: State-wise distribution of weekly trips by trip length (per capita)



Trip purpose

Figure 8 shows the distribution of weekly trips by purpose of travel. Forty percent of the trips relate to work, 21 percent to education and 28 percent to market/mandi. The increase in the number of trips for visits to market/mandi is a direct result of improvement in economic activities.

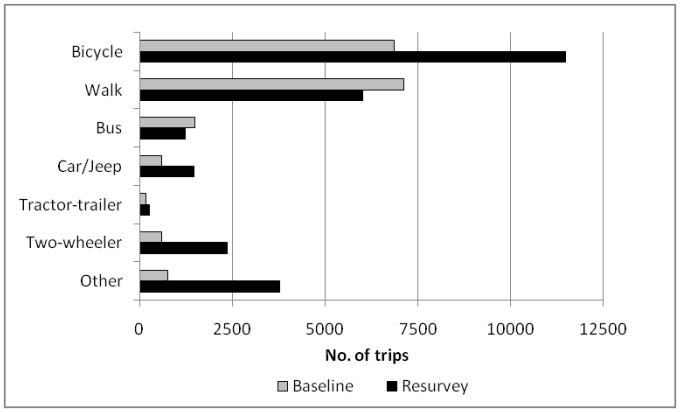
Figure 8: Distribution of weekly trips by purpose



Mode of travel

Figure 9 shows the distribution of weekly trips by mode of travel. Most of the trips are undertaken by bicycle or on foot. However, the number of trips on foot has declined. Trips undertaken by using the motorized modes of transport have increased. This indicates improvement in the purchasing power of the rural population.

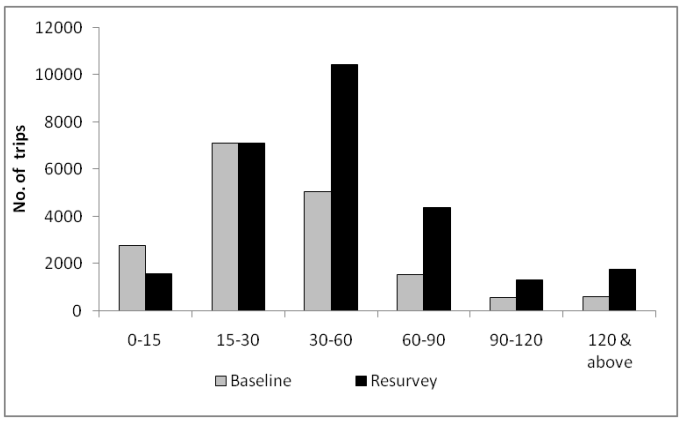
Figure 9: Distribution of weekly trips by mode of travel



Trip time

Figure 10 shows the distribution of weekly trips by travel time. The resurvey data shows that at the aggregate level most of the trips involve travel time of 30-60 minutes.

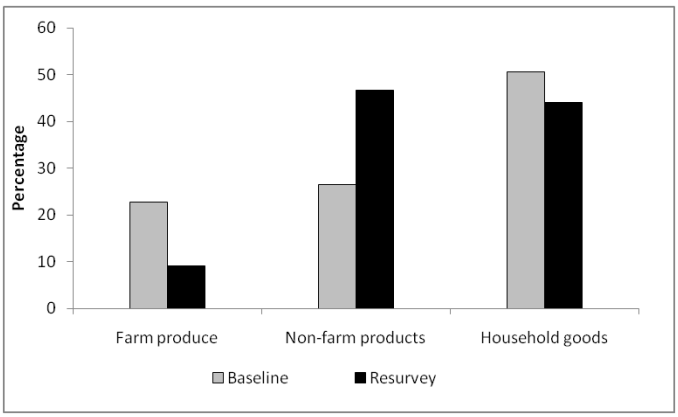
Figure 10: Distribution of weekly trips by travel time in minutes



Carriage of commodities

Figure 11 shows distribution of trips for carrying household goods, farm produce and non-farm products. The share of trips for carrying non-farm products has gone up; for farm produce, it has declined. This is consistent with the overall transition taking place in local economies with households shifting to non-agricultural work.

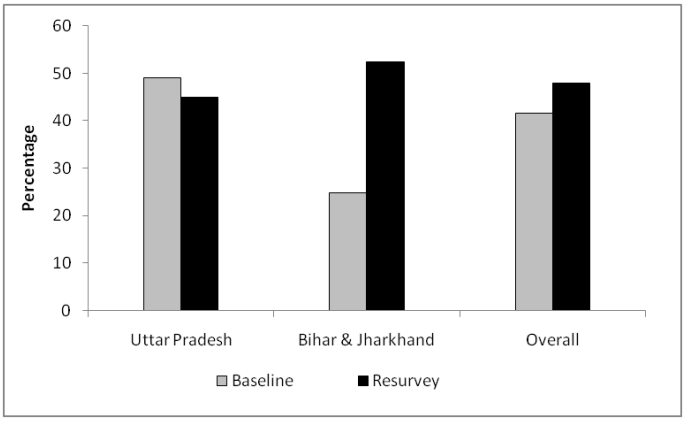
Figure 11: distribution of trips for carrying goods



Role of national highway in rural mobility

Figure 12 shows percentage of total trips involving use of the highway. Almost 50 percent of the total trips originating from the surveyed villages involve use of the highway. This high proportion shows that the highway plays an important role in meeting the transport requirements of the rural population.

Figure 12: Percentage of total trips involving the use of the highway



Concluding observations

Contrary to the traditional view that a national highway primarily facilitates intercity travel and transport of goods, the study has shown that it is also an important and integral part of the road network serving rural areas. This is borne out by the fact that almost 50 percent of the total trips originating from the selected villages involve the use of the national highway.

This brings out the need for building service roads along the highways for slow-moving traffic – pedestrians, cyclists, bullock carts, etc. Equally important is the safe design of road crossings between highways and village roads. A large number of villages are connected to the highway by kutcha roads. The upgrading of these roads would then enable the realization of full potential of the highway.

Overall, the levels of mobility have shown a marked increase of 60 percent – 8.7 trips a week as compared to 5.49 in the baseline. More trips are being undertaken for visiting mandis, markets, and for work, education and health. This development alone underscores the importance of the growing local economies.

Bicycles account for over 76 percent of the total number of vehicles owned by the households. This share was 87 percent at the time of the baseline survey. The share of motorised vehicles has doubled from 8.6 percent to 16 percent. Among the motorised vehicles, two-wheelers – scooters and motorcycles – predominate. The share of motorised vehicles is found to be higher in the vicinity of the highway.

Most trips are made on foot or by bicycle and two wheelers. However, the number of trips on foot has declined. The average trip length continues to be relatively short with more than half the trips being undertaken within a distance of 5 km. This finding in a way corroborates the hypothesis of delineating the influence zone of 5 km.

Concepts and Definitions

The concepts and definitions of some of the important terms used in the baseline survey schedules or referred to in the present report are explained below. The technical terms have been explained, only with a view to enabling the lay reader to understand the context of the narration.

Access: It is the ability to reach, visit, or use a service, and encompasses two factors of mobility and proximity.

Accessibility: It is a term often used in transport and land use planning and is generally understood to mean 'ease of reaching' (Jones, 1981).

Acre: A unit of surface area (equivalent to 4047 sq.m.)

Agricultural Labour: A person is considered as agricultural labour, if he/she follows one or more of the following agricultural occupations in the capacity of a wage-paid manual labour, whether paid in cash or kind or both: (i) farming, (ii) dairy farming, (iii) production of any horticultural commodity, (iv) raising of livestock, bee-keeping or poultry farming, (v) any practice performed on a farm as incidental to or in conjunction with farm operations (including forestry and timbering), preparation for market and delivery to storage or to market or to carriage for transportation to market of farm produce. Working in fisheries is excluded from agricultural labour. Further, 'carriage for transportation' refers only to the first stage of transport from farm to the first place of disposal. *(Source: NSSO)*

Agricultural Marketing Societies: These societies are formed by groups of farmers with the objective of getting better prices for their products. Their activities include collection, processing, selling, and transporting the products of their members.

Agricultural Production: An occupation category which includes growing of (i) cereal crops (paddy, wheat, jowar, bajra, maize, ragi, barley, etc.), (ii) pulses (arhar, gram, moong, urad, etc.), (iii) cotton, (iv) jute, mesta, sann hemp or other kindred fibres, (v) oilseeds, (vi) sugarcane or sugar beet, (vii) roots and tubers, vegetables, singharas, chillies and spices (other than pepper and cardamom), (viii) fodder crops; floriculture and horticulture including tree nurseries; and agricultural production not elsewhere classified. *(Source: Census of India)*

Agro-climatic Zone: A division of the country based on physical and climatic considerations for an optimum farming system of crop production. The agro-climatic division (zoning) broadly takes into account the soil characteristics, climate, rainfall, and water availability. The country has been divided into 15 zones for the purposes of national agricultural economy:

(i) Western Himalayan	(ii) Eastern Himalayan	(iii) Lower Gangetic Plains
(iv) Middle Gangetic Plains	(v) Upper Gangetic Plains	(vi) Trans- Gangetic Plains
(vii) Eastern Plateau and Hills	(viii) Central Plateau and Hills	(ix) Western Plateau and Hills
(x) Southern Plateau and Hills	(xi) East Coast Plains and Hills	(xii) West Coast Plains and Ghats
(xiii) Gujarat Plains and Hills	(xiv) Western Dry	(xv) Islands

(Source: Planning Commission)

Arithmetic Mean or ***Mean:*** It is the sum of a set of numbers divided by the number of cases in the set. It is denoted as $\overline{X} = (\sum X)/N$.

Artisans: An occupation category which includes (i) sculptors, painters and related artists; (ii) commercial artists, interior decorators and designers; (iii) movie camera operators; (iv) photographers; (v) composers, musicians and singers; (vi) choreographers; (vii) actors; (viii) stage and film directors and producers (performing arts); (ix) circus performers (excluding rope dancers and acrobats); (x) dancers; (xi) rope dancers; (xii) acrobats; and (xiii) snake charmers. *(Source: Census of India)*

Attached Labour: Contract labour for a specified period of agricultural season.

Average Cost: Cost per unit of output, where the costs of all inputs (factors of production) are included. Thus, the average cost (AC) may be written as: AC = (TC/X), where X is output and TC is the total cost. Average cost comprises average fixed cost (AFC) and average variable cost (AVC).

Average Daily Traffic (ADT): Average number of vehicles that pass a specified point during a 24-hour period.

Average Travel Cost: It is the average cost of travel taking all trips into account; also expressed as a ratio of total trips to total cost.

Average Travel Time: It is the average time of travel taking all trips into account; also expressed as the ratio of total trips to total travel time.

Average Trip Length*:* It is the average distance of travel taking all trips into account.

Bias: It may be said to exist when the value of a sample statistics shows a persistent tendency to deviate in one direction from the value of the parameter.

Big Business (Organised Sector Enterprise): It refers to those enterprises which are registered under the Factory Act, 1948, and have 10 or more employees, using power for their operations; or have 20 or more employees and carry out their operations without power *(Source: CSO)*.

Bigha: One fifth of an acre (equivalent to 809 sq.m.)

Casual Wage Labour: A person who is casually engaged in others' farm or non-farm enterprises (both household and non-household) and, in return, receives wages according to the terms of the daily or periodic work contract. Usually, in the rural areas, a type of casual labourers can be seen who normally engage themselves in 'public works' activities. 'Public works' are those activities which are sponsored by the government or local bodies for constructing roads, bunds, digging ponds, etc. as 'test relief' measures (like flood relief, drought relief, or famine relief.) and also employment-generation schemes under poverty alleviation programmes (NREP, RLEGP, etc.). *(Source: NSSO)*

Co-efficient of Variation (CV): The coefficient of variation is defined as: CV = $\frac{\sigma}{\bar{x}} \times 100$, where σ is the standard deviation and $\bar{x}$ is the mean. It is used to compare two or more series where the means differ significantly and where the standard deviation is an inadequate measure of dispersion.

Community Health Centre: It is an upgraded primary health centre provided in each community development block, covering a population of one lakh. It has up to 30 beds and is equipped with X-ray and other laboratory facilities. The centre has a specialist each in surgery, medicine, obstetrics, gynaecology, and pediatrics.

Community Water Supply: Irrigated water supply for a group of people living in a particular area.

Community Wells: Wells dug for the purpose of providing drinking water to a group of people living in a particular area.

Confidence Interval: It is a random interval for a parameter constructed from data in such a way that the probability of that interval contains the true value of the parameter which can be specified before the data are collected.

Confidence Level: It is the chance that the interval which will result once data are collected will contain the corresponding parameter in a confidence interval. If one computes confidence intervals again and again from independent data, the long-term limit of the fraction of intervals that contain the parameter is the confidence level.

Construction Worker(s): Workers classified under this category are: (i) bricklayers, stone masons and tile-setters; (ii) reinforced concreters, cement finishers and terrazzo workers; (iii) roofers (iv) parquetry

workers; (v) plasterers; (vi) insulators; (vii) glaziers; (viii) hut builders and thatchers; and (ix) well diggers. *(Source: Census of India)*

Consumer Price Index: A measurement of average changes in prices paid by consumers of a fixed basket of a wide variety of goods and services *(Source: CSO).*

Control Zone (Control Area): It is the area which will be least influenced by the impact of the project. The control zone enables comparison with the influence zone for the purpose of assessing the net socio-economic impact of the project. This comparison is done under two situations – before and after the implementation of the project – so as to isolate the effects of other simultaneous development initiatives or processes (for the current study, the control zone is the area extending beyond an approach distance of 5 km within the horizontal distance band of 7 km on either side of the national highway).

Co-operative: A business owned by people who use its services. Some cooperatives sell goods or services produced by their members. In the case of other cooperatives, farmers and other consumers as a group buy directly from suppliers. By reducing expenses, these organisations often provide lower costs for consumers and higher earnings for producers.

Correlation Coefficient: Given a pair of related measures (X and Y) on each of a set of items, the correlation coefficient (r) provides an index of the degree to which the paired measures co-vary in a linear fashion.

Cost-Benefit Analysis: The appraisal of an investment project which includes all social and financial costs and benefits accruing to the project. It is the technique adopted in investment appraisal in order to evaluate and decide whether a proposed project should proceed, i.e. its benefits would exceed its costs.

Cross-section Data: A set of data which are collected at one point of time.

Cultivation: All activities related to crop production including ancillary activities are considered as cultivation. Growing trees, plants, vegetables or of crops as plantation or orchards (such as rubber, cashew, coconut, pepper, coffee, tea, etc.) is not considered as cultivation activity. *(Source: NSSO)*

Cultivator: A cultivator is one engaged as employer, single worker or family worker in cultivation of crops on land owned or held from government or private persons for payments in money, kind or share. *(Source: Census of India)*

Degrees of Freedom: This term is used to describe the number of values in the final calculation of a statistic that are free to vary.

Demand: It is the desire for a commodity backed by ability and willingness to pay.

Development Block: An administrative unit coterminous with the jurisdiction of Panchayat Samiti.

Dhaba: A small open eating place on the roadside, offering inexpensive eatables.

District Rural Development Agency: It is the government nodal agency at the district level which supports and finances micro development projects in the field of land and water resources.

Double Difference Method: A method of assessing the socio-economic impact of a project (Explained in detail in the text).

Drought: A situation when the deficiency of rainfall at a meteorological sub-division level is 25 percent or more of the long-term average of that sub-division for a given period. The drought is considered 'moderate', if the deficiency is between 26 and 50 percent, and 'severe' if it is more than 50 percent.

Dummy Variable: A binary (off-on) variable designed to take account of exogenous shifts (shift dummy) or changes of slope (slope dummy) in an econometric relationship. For instance, dummies can

be used to account for seasonal influences in the data. By specifying a dummy to take on the value of unity of, say, winter months, and zero at other times, it will indicate the degree to which a relationship shifts during the winter, compared to other seasons, by augmenting the constant term of the equation. This type of variable can also be used to include qualitative factors in a regression.

Economic Activity: Any activity resulting in the production of goods and services that add value to national product is considered economic activity. Such activities include producing goods and services for the market (market activities), i.e. production for pay or profit, and the production of primary commodities for own consumption and own account production of fixed assets, among the non-market activities. *(Source: NSSO)*

Economic Development: The process of improving the standard of living and well-being of the population by raising per capita income.

Economic Growth: Typically taken to mean an increase in the real level of net national product. The measure is sensitive to the way in which national product is measured. Thus, an economy with a large sector containing bartered goods or unrecorded consumption of its own products (e.g., farmers' consumption of their own produce) may raise its level of national product without the recorded level showing an increase.

Economies of Scale: Reduction in the average cost of a product in the long run, resulting from an expanded level of output. Also known as long-run increasing returns.

Elasticity of Demand: It is the proportionate change in demand due to change in price.

Employed: *See 'Worker(s)'.*

Employee: A worker who is hired to perform a job.

Employment: The state of being employed or having a job *(Source: NSSO).*

Endogenous Variable: A variable whose value is determined within the framework of an economic or econometric model. Thus, if a variable appears as a dependent variable in an equation, it is an endogenous variable.

Enterprise: It is an undertaking which is engaged in the production and/or distribution of some goods and/or services meant mainly for the purpose of sale, whether fully or partly. An enterprise may be owned and operated by a single household, or by several households jointly, or by an institutional body. *(Source: NSSO)*

Establishment: Those enterprises which have got at least one hired worker on a 'fairly regular basis' are called establishments. *(Source: NSSO)*

Exogenous Variable: A variable whose value is not determined within an economic model, but which plays a role in the determination of the values of endogenous variable. Thus, an exogenous variable is an explanatory variable but never appears as a dependent variable in the model.

Explanatory Variable: A variable which plays a part in 'explaining' the variation in a dependent variable in a regression analysis.

Expressway: A highway with divided carriageway, controlled access, generally provided with grade separations at intersections and permitting only fast-moving vehicles.

Externalities: Externalities are variously known as external effects, external economies and diseconomies, spillovers and neighbourhood effects. Externalities involve an interdependence of utility and/or production function. For example, the upstream pulp mill which discharges effluent in the river, thus reducing the scope of fishing downstream, is said to impose an externality on the fishermen. A beneficial externality, known as an external economy, is where an externality-generating activity raises the production or utility of the externally-affected party. For example, a beekeeper may benefit

neighbouring farmers by incidentally supplying pollination services. An external diseconomy is where the externality-generating activity lowers the production or utility of the externally-affected party. Examples of this are the numerous forms of environmental pollution.

Factor Analysis: An analytical technique for identifying the major inter-relationships between variables, frequently used in transportation demand analysis.

Factors of Production: The resources used in the process of production. These are usually divided into three main groups – land, labour, capital – but may also include entrepreneurship.

Financial Institution(s): It includes any bank, thrift institution, insurance company, investment advisory firm.

Firm: Analytical label for an institution which transforms inputs into output. Thus, a firm is viewed as an abstract entity which mainly fulfils technical role.

Fishing: An occupation category which includes: (i) ocean, sea and coastal fishing; (ii) inland water fishing; (iii) pisciculture: rearing of fish, including fish hatcheries; (iv) collection of pearls, conches, shells, sponges and other sea products; (v) cultivation of oysters for pearls; and (vi) other allied activities and services incidental to fishing not elsewhere classified. *(Source: Census of India)*

Flood: The rising of a body of water and its overflowing on to normally dry land.

Forestry: An occupation category which includes: (i) planting, replanting and conservation of forests; (ii) logging, felling and cutting of trees and preparation of rough, round, hewn or riven logs (including incidental hauling); (iii) production of firewood/fuel wood (including charcoal by burning); (iv) gathering of fodder; (v) gathering of uncultivated materials, such as gums, resins, lac, barks, munjh, herbs, honey, wild fruits, leaves, etc.; and (vi) forestry services not elsewhere classified. *(Source: Census of India)*

Gender: The term refers to the socially constructed roles ascribed to males and females and the resulting socially determined relations. These roles change over time, and vary widely within and across cultures. Gender is one of the key entry points for social analysis/assessment.

General Equilibrium: A situation where all markets in an economy are simultaneously in equilibrium (i.e. where prices and quantities don't change). Economists have traditionally adopted two approaches in analysing economic systems. The simpler approach is associated with partial equilibrium, where only a part of the equilibrium is examined, on the assumption of unchanged condition in the rest of the economy. The second approach, the general equilibrium analysis, looks at an economic system as a whole and observes the simultaneous determination of prices and quantities of all goods and services in the economic system.

Geometric Mean: It is the *n*th root of the product of a set of values. For example, the geometric average of the values 2,2,4, and 16 is the 4^{th} root of 256, which is 4. The arithmetic average of the same set of values is 6.

Government Enterprise: Enterprise owned by the state.

Gram Sabha: A body consisting of persons registered on the electoral rolls relating to a village included within the area of Panchayat.

Gross Domestic Product (GDP): A measure of the total flow of goods and services produced by the economy over a specified time period, normally a year or quarter. It is obtained by valuing the output of goods and services at market prices and then aggregating. All final consumption or investment goods or changes in the stocks are included. This is because the values of intermediate goods are implicitly included in the prices of final goods. The word 'gross' means that no deduction for the value of expenditure on capital goods for replacement purposes is made. Because the income arising from

investment and possessions owned abroad is not included, only the value of the flow of goods and services produced in the country is estimated.

Hectare (ha): A unit of surface area equal to 10,000 sq.m.

Highway: A general term denoting a public way for purposes of vehicular movement; or an important road in a road system.

Highway Classes by Function: The road network in the country has been classified into: National Highways, State Highways, Major District Roads, Other District Roads and Village Roads *(see definitions under specific nomenclature).*

Hired Labour: Workers hired to perform a job.

Home-Based Trips: Trips which have one end (origin or destination) at the home of the person making trip.

Home Interview Survey: A survey in which the data are collected at home through face-to-face interviews. Such interviews usually cover information on household characteristics and travel patterns.

Hospital: Apart from primary health centres, the present organisation of health services of the government sector consists of rural hospitals, sub-divisional/tehsil/taluka hospitals, district hospitals, specialist hospitals and teaching institutions. Unlike a health centre whose services are preventive, promotive and curative, in a hospital, services provided are mostly curative. The hospital has no specified catchment area.

House: Any structure, tent, shelter, etc., is a house irrespective of its use. It may be used for residential or non-residential purposes or both or may even be vacant. *(Source: Census of India)*

Household: A group of persons normally living together and taking food from a common kitchen. The adverb 'normally' means that temporary visitors are excluded but temporary stay-aways are included. 'Living together' is given more importance than 'sharing food from a common kitchen' in drawing the boundaries of a household, in case the two criteria are in conflict. *(Source: NSSO)*

Household Industry: An industry conducted by one or more members of the household at home or within the village in rural areas, and only within the precincts of the house where the household lives in urban areas. *(Source: Census of India)*

Household Size: The total number of persons normally residing together in a household including temporary stay-aways, but excluding temporary visitors and guests.

Imperfect Competition: A generic term which may be used in two ways. The first refers to any form of market structure other than perfect competition and would thus include monopolistic competition, oligopoly and monopoly. The second definition of the term refers to any market structure other than perfect competition and monopoly.

Influence Zone (Influence Area): It is the area showing significant socio-economic impact of the project on the population (for the present study, the influence zone has been delineated as an area extending up to an approach distance of 5 km on either side of the national highway).

Informal Sector: It is broadly characterised as comprising production units that operate on a small scale and at a low level of organisation, with little or no division between labour and capital as factors of production, and with the primary objective of generating income and employment for the persons concerned. Operationally, the sector is defined on a country-specific basis as the set of unincorporated enterprises owned by households which produce at least some products for the market but which either have less than a specified number of employees and/or are not registered under national legislation referring, for example, to tax or social security obligations, or regulatory acts.

Katcha House: House built with unbrunt bricks but the roof covered with tiles.

Kharif: Agricultural season corresponding to summer months.

Labour Force: Persons who are either 'working' (or employed) or 'seeking work or available for work' (or unemployed) together constitute the labour force. Persons who are neither 'working' nor 'seeking work or available for work' for various reasons are considered 'out of labour force'. The persons under this category include students, those engaged in domestic duties, rentiers, pensioners, recipients of remittances, etc. and casual labourers not working due to sickness. *(Source: NSSO)*

Land Possessed: Land possessed means land owned (including land under owner-like possession) + land leased in – land leased out + any land possessed by the household which is neither owned nor leased-in. A plot of land is considered to be 'owned by the household' if permanent heritable possession, with or without the right to transfer the title, is vested in a member or members of the household. Land held in owner-like possession under long-term lease or assignment is also considered as land owned. As regards lease, land given to others on rent or free by owner of the land without surrendering the right of permanent heritable title is defined as leased out. Land leased-in is defined as land taken by a household on rent or free without any right of permanent or heritable possession. The lease contract may be written or oral. If the household has possession of land for which it lacks title of ownership and also does not have any lease agreement in the case of the land transacted either verbally or in writing, such land will be considered as 'neither owned nor leased-in'. *(Source: NSSO)*

Land Utilisation: It is the categorisation of land under operational holding. The broad categories are:

(a) *Net Sown Area*: This represents the total area sown with crops and orchards counting only once the area sown more than once in the same year.

(b) *Current Fallow Land*: This represents the areas of any classification which were cropped during the previous year of the reference year, but were kept fallow during the current year. If any seedling area is not cropped in the same year, it is treated as current fallow land.

(c) *Other Cultivated Land excluding Fallow Land*: This includes:

  (i) *Permanent Pastures and Grazing Lands*: All grazing land whether they were permanent pastures or meadows are included in this category.

  (ii) *Land under Miscellaneous Use:* Cultivable land which is not included in the net sown area, but is put to some agricultural use, and land under thatching grasses, bamboo bushes, casurina trees and other groves for fuel etc., which are not included under 'orchards' are classified under this category.

(d) *Fallow Land Other than Current Fallow*: This category includes land taken up for cultivation, but have been temporarily out of cultivation for a period of more than one year and not more than five years previous to the reference year for one reason or the other.

(e) *Culturable Waste Land*: This includes land for cultivation, whether not taken up for cultivation any time or taken up for cultivation once but not cultivated during the current year and the last five years or more in succession for one reason or the other. Such land may be either fallow or covered with shrubs and jungles.

(f) *Land Not Available for Cultivation*: This includes:

  (i) *Forests*: All land classed as forests under any legal enactment dealing with forests or administered as forests, whether state-owned or private, and whether wooded or maintained as potential forest land.

  (ii) *Area under Non-agricultural Uses*: All land occupied by buildings and other lands put to uses other than agriculture within the operational holdings are included in this category.

(iii) *Barren and Uncultivable Land*: All barren and uncultivable land like steep hills, eroded lands, unproductive lands, etc. and the lands which are not fit for cultivation or which cannot be brought under cultivation unless at a high cost are included in this category. *(Source: Agricultural Census, 1990-91, Ministry of Agriculture, Government of India)*

Livestock Occupation: An occupation category which includes (i) cattle breeding, rearing and ranching etc., production of milk; (ii) goat breeding, rearing, ranching etc., production of milk; (iii) rearing of sheep and production of shorn wool; (iv) rearing of horses, mules, camels and other pack animals; (v) rearing of pigs and other animals not elsewhere classified; (vi) rearing of ducks, hens and other birds, production of eggs; (vii) rearing of bees, production of honey and wax; (viii) rearing of silk-worms, production of cocoons and raw silk; and (ix) rearing of livestock and production of livestock products not elsewhere classified. *(Source: Census of India)*

Local Wage Labour: Wage labour (both agricultural and non-agricultural) in a particular locality or neighbourhood.

Logit Model: *Described in the text of the report.*

Long-Run Marginal Cost (LRMC): The extra cost of producing an extra unit of output in the long run.

Long Run: A time-period relating to the process of production during which there is time to vary all factors of production, but not sufficient time to change the basic technological processes being used.

Main Worker: A worker engaged in any economically productive activity for 183 days or six months or more during the year. *(Source: Census of India)*

Major District Roads (MDR): These are branch roads of the state and national highways and serve as the main roads for intra-district movements. They traverse the length and breadth of a district connecting the areas of production and marketing in the district to one another and to the national highways.

Mandi: A market centre found in an urban area for trading agricultural products, generally having storage and warehousing facilities.

Manual Work: A job essentially involving physical labour. Jobs essentially involving physical labour but also requiring a certain level of general, professional, scientific or technical education are not termed manual work. On the other hand, jobs not involving much of physical labour and at the same time not requiring much educational (general, scientific, technical or otherwise) background are treated as 'manual work'. Thus, engineers, doctors, dentists, midwives, etc. are not considered as manual workers even though their jobs involve some amount of physical labour. But peons, watchmen, etc. are considered as manual workers even though their work may not involve much physical labour. Manual work covers the following occupational groups of the National Classification of Occupations – service workers; farmers, fishermen and related workers, and production and related workers. *(Source: NSSO)*

Manufacturing: Manufacturing is the process of transformation of raw materials into final products.

Marginal Benefit: The additional benefit obtained by consuming the last (or next) unit of a commodity.

Marginal Cost: The extra cost of producing an extra unit of output. Algebraically, it is written as: MC = ($\Delta C/\Delta X$), where Δ means 'a small change in', C is Total Cost and X is output.

Marginal Social Benefit: The benefit associated with producing one more unit of a good or service. When positive externalities are present, they must be added to marginal private benefits to obtain marginal social benefits (Hyman, 1983).

Marginal Social Cost(s): Costs that represent the total value of resources used to produce one more unit of output of a good or service (Hyman, 1983).

Median: It is the value of a series which splits an ordered list of cases into two halves, i.e. the middle value, in the sense that an equal number of cases lie above this value as below it.

Mobility: The ability of an individual/group to physically move from one place to another.

Mode: It is the value of a series that occurs most often. The term is also used to refer to a particular mode of transport.

National Highways (NH): The national highways constitute the primary network of the road system in the country. Under the Constitution, these highways are a union subject and their development and maintenance are the responsibility of the Government of India. These are the arterial roads for inter-state and strategic defence movements. They traverse the length and breadth of the country connecting the national and state capitals, major ports and rail junctions and link up with border roads and foreign highways.

Non-parametric Method: *Described in the text of the report.*

Non-Sampling Error: The errors mainly arising at the stage of acquiring, recording and processing of data are termed non-sampling errors. They are common both in complete enumeration and sample survey. Non-sampling errors include biases and mistakes.

Non-workers: Those who have not worked any time at all during the year. Non-workers include (i) those engaged in household duties at home, (ii) students, (iii) dependents, (iv) retired or rentiers, (v) beggars, (vi) inmates of institutions and (vii) other non-workers. *(Source: Census of India)*

Null Hypothesis: It is a term that statisticians often use to indicate the statistical hypothesis tested. The purpose of most statistical tests is to determine if the obtained results provide a reason to reject the hypothesis that they are merely a product of chance factors.

Nyaya Panchayat: A body of village elders constituted to mete out justice, locally.

Operational Holding: An operational holding is defined as all land which is wholly or partly used for agricultural production and operates as one technical unit by one person alone or with others without regard to title, legal form, size of location. It is, thus, distinct from an ownership holding. For the purposes of this definition, a 'technical unit' is the unit which under the same management has the same means of production, such as labour force, machinery and animals. The 'total area of holding' includes all the lands forming part of a unit which is under the same technical responsibility and management. It comprises all the land occupied by the farm buildings including the house of the holder, provided such buildings are within the cultivated area *(Source: Agricultural Census, Ministry of Agriculture).*

Opportunity Cost: The opportunity cost of a commodity is the value of the best alternative use to which the resources could have been put; the value of the productive opportunities foregone by the decision to use them in producing that commodity (Evans, 1984).

Other District Roads (ODR): These roads serve rural areas and provide them with outlets to market centres, taluka/tehsil headquarters, block development headquarters or other main roads.

Own Account Enterprise (OAE): It is an undertaking run by household labour, usually without any hired worker employed on a 'fairly regular basis'. By 'fairly regular basis' is meant the major part of the period of operation(s) of the enterprise during the last 365 days. *(Source: NSSO)*

Panchayati Raj Institutions: The three-tier institutions of elected local self-government for rural areas having constitutional status (Article 243B of the Constitution of India). These are Panchayat, Panchayat Samiti and Zilla Parishad.

Panchayat: It is the first tier of the institution of self-government at the village(s) level. The electoral body called Gram Sabha consists of persons registered in the electoral rolls relating to a village included within the area of Panchayat.

Panchayat Samiti: It is the tier above the Panchayat with its territorial area usually congruous with an administrative Development Block.

Panchayat Area*:* It means the territorial area of a Panchayat.

Pradhan/ Mukhia / Sarpanch: Chairperson of Panchayat.

Panel Data: A type of pooled cross-section time series data in which the same cross-section is sampled over time. Panel data are usually microeconomic data arising from individual economic agents, such as households or firms.

Parameter: A numerical property of a population, such as its mean.

Parametric Approach: Methods which test hypotheses using data samples assuming that the data comes from a normal distribution.

Participatory Rural Appraisal (PRA): PRA is a research and planning methodology for studying the community wishes and values in villages, or rural areas. It enables local people to share, enhance and analyse their knowledge of life and conditions, to plan and to act. Many definitions have been stated by several researchers. Robert Chambers (1992) defines PRA as 'a family of approaches and methods to enable rural people to share, enhance, and analyse their knowledge of life and conditions, to plan and to act'. Eileen Kane (1997) defines PRA as 'a flexible research strategy which draws on community expertise and involvement to get action-based, timely, cost-effective and reliable information'. James and Karen (1997) define PRA as 'a research and planning methodology in which a local community studies an issue that concerns the population, prioritises problems, evaluates options for solving the problem(s) and comes up with a Community Action Plan'. Somesh Kumar (2002) defines PRA as 'a radical personal and institutional change which is intended to enable local people to conduct their own analysis, and often to plan and take action'.

Population Density: Number of persons per square kilometre.

Population Mean: The mean of the numbers in a numerical population. For example, the population mean of a box of numbered tickets is the mean of the list compiled of all the numbers on all the tickets. The population mean is a parameter.

Population Standard Deviation: The standard deviation of the values of a variable for a population. This is a parameter, not a statistic.

Population: It is a collection of units being studied. The units can be people, places, objects, drugs, procedures, or many other things. Much of the statistics is concerned with estimating numerical properties (parameters) of an entire population from a random sample of units from the population.

Post Office: The government department responsible for mail delivery (and sometimes telecommunications).

Poverty: An unacceptable deprivation in well-being having many dimensions, both economic and non-economic, material deprivation being a critical component.

Poverty Line: The minimum norm that defines a standard of consumption, anchored in food consumption, which is socially accepted as the minimum desirable. The levels and composition of non-food items included in the minimum standard are taken to be whatever happens to go along with the fulfilment of the calorie norm. Together, they are used to determine the value of per capita consumption expenditure which defines the national poverty line (PL). In India, per capita consumption expenditure, which meets the average calorie requirement of 2400 kcal in rural areas and 2100 kcal in

urban areas along with associated quantities of non-food expenditure is the cut-off line for determining poverty. Persons having consumption expenditure below the laid down norms are treated as 'Below Poverty Line' *(Source: Planning Commission)*.

Poverty Mapping: It is the spatial representation and analysis of indicators of human well-being and poverty within a region.

Poverty Ratio/Headcount Ratio: It is the ratio of persons living below the poverty line to the total number of people. In other words, if the number of persons below the poverty line is 'q' and the total number of population be 'n' then the headcount ratio (H) is defined as H=q/n *(Source: Planning Commission).*

Primary Health Centre (PHC): It is a basic health unit to provide, as close to the people as possible, integrated curative and preventive healthcare to the rural population with emphasis on preventive and promotive aspects of health care. The national health plan provides for one primary health centre for every 30,000 rural population in the plains, and one PHC for 20,000 population in hilly, tribal and backward areas. The functions of PHC cover all the eight essential elements of primary health care as outlined in the Alma Ata Declaration. These include (i) medical care, (ii) maternity and child homes including family planning, (iii) safe water supply and basic sanitation, (iv) prevention and control of locally endemic diseases, (v) collection and reporting of vital statistics, (vi) education about health, (vii) natural health programmes – as relevant, (viii) referral services, (ix) training of health guides, health workers, local *dais* and health assistants, and (x) basic laboratory services. Each PHC is manned by one medical officer, one block extension educator, one health assistant (male), one health assistant (female), and supporting staff (e.g., compounder, driver, laboratory technician).

Primary Health Sub-centre: It is the peripheral outpost of the existing health delivery system in rural areas. Its function is now limited to mother and child healthcare, family planning and immunisation. A sub-centre is generally established on the basis of one unit for every 5000 population and one unit for every 3000 population in hilly, tribal and backward areas. Each sub-centre is manned by one male and one female multipurpose health worker.

Primary School: A school having classes up to IVth standard only.

Private Enterprise: Enterprises owned by individuals and firms.

Probability: A number between 0 and 1 which represents how likely an event is to occur. Events with probability equal to 0 never occur. Events with probability equal to 1 always occur.

Probit Model: *Described in the text of the report.*

Propensity Score Matching: *Described in the text of the report.*

Pucca House: House built with burnt bricks, G.I. sheets, other metal sheets, stone, cement concrete, etc. *(Source: Ministry of Rural Development)*.

Rabi: Agricultural season corresponding to winter months.

Random Numbers: A set of numbers used for generating samples from a given population.

Random Sampling: A random sample is a sample in which every member of the population or some sub-set of the population being tested has an equal chance of being included in the sample.

Regional Rural Bank: A bank whose main objective is to develop rural economy by providing credit and facilities for the development of agriculture, trade, commerce, industry and other productive activities in the rural areas, particularly to small and marginal farmers, agricultural labourers, artisans and small entrepreneurs.

Regression: A mathematical technique for estimating parameters of an equation from set of data of independent and dependent variables.

Regular Salaried/Wage Employees*:* Persons working in others' farm or non-farm enterprises (both household and non-household) and, in return, receiving salary or wages on a regular basis (i.e. not on the basis of daily or periodic renewal of work contract). The category not only includes persons getting time wage but also those receiving piece wage or salary and paid apprentices, both full-time and part-time.

Rent: The income accruing to the owner for the services of durable goods, such as a piece of land, property or a computer.

Rentier: A person who is living on agricultural or non-agricultural royalty, rent or dividend is classified under this category (Source: *Census of India*).

Resource Mapping: The resource map focuses on the natural resources in the locality and depicts land, hills, rivers, fields, vegetation, etc., and may include habitation as well. It is not drawn to scale and is not done by experts, but by the local people themselves.

Response Code: It shows the quality of survey by collecting information on the type of informant, considering his co-operation and capability in providing the required information.

Retired Person: A person who has retired from service and is doing no other work, i.e. is neither employed in the same work nor engaged in some other work, such as cultivation, business, trade, etc. (Source: *Census of India*).

Returns to Scale: The proportionate increase in output resulting from proportionate increase in all inputs. If the number of workers, raw materials and machines used by the firms are all doubled, three situations can result: *decreasing returns to scale* hold if output is less than doubled; *constant returns to scale* would exist if output exactly doubled; and *increasing returns to scale* would hold if output is more than doubled.

Road: A way on land with a right of way for the public.

> *Paved Road (PR):* A road provided with a hard pavement course, which should be at least a water-bound-macadam layer. A paved road need not necessarily be surfaced or black-topped.
>
> *Unpaved Road (UPR)/Katcha Road:* A road not having a hard pavement course (which should be at least a water-bound-macadam layer). Thus, earthen road and gravel road will be unpaved roads.
>
> *Black-Topped Road (BTR):* A road provided with a bituminous surfacing.
>
> *Gravel Road (GR):* A road constructed using well compacted crushed rock or gravel material, which is fairly silent and does not become slippery when wet.
>
> *All-weather Road:* An all-weather road is one which is negotiable during all weathers, except at major river crossings. This implies that the road-bed is drained effectively by adequate cross-drainage structures such as culverts, minor bridges and causeways. Interruptions to traffic as per permitted frequency and duration are, however, allowed. The pavement should be negotiable during all-weathers, but this does not necessarily imply that it should be paved or surfaced or black-topped.

R-squared: A statistic employed in regression analysis that measures how much variance has been explained by the regression model. Specifically, it is the proportion of the total variability (variance) in the dependent variable that can be explained by the independent variables. R-squared is also employed as a measure of goodness of fit of the model. R-squared ranges from 0 to 100 percent. If all the observations fall on the regression line, R-squared is equal to 100 percent. The variability in the

dependent variable is partitioned into two component sums of squares: variability explained by the regression model and unexplained variation. To calculate R-squared, the regression sums of squares are divided by the total sums of squares. In a simple regression, R-squared can also be obtained by squaring the correlation coefficient.

$\overline{R}^2$ ***(Adjusted R-squared):*** The regression R-squared statistic 'corrected' for the number of independent variables in a multiple regression analysis. It is often used to compare models involving different numbers of coefficients. The adjusted R-squared statistic is interpreted as:

(i) a measure of the goodness of fit of the least squares regression line.

(ii) the proportion of variance in the dependent variable accounted for by the independent variables.

Rural Labour*:* Manual labour (by a person living in rural area) in agricultural and/or non-agricultural occupations in return for wages/salary paid either in cash or kind (excluding exchange labour) and living in rural areas, is taken as 'rural labour'.

Sample: A set of observations, usually taken from collection of units being studied, i.e. the population.

Sample Mean: The arithmetic mean of a random sample from a population. It is a statistic commonly used to estimate the population mean.

Sample Number: The number assigned to a household selected from the list of households.

Sample Size: The number of elements in a sample from a population.

Sampling Error: The error arising due to drawing of inference about population on the basis of a few observations (sampling). Such errors are non-existent in complete enumeration survey.

Sarpanch / Pradhan/ Mukhia: Chairperson of Panchayat.

School - Middle: A school having classes up to VIIIth standard only.

School - High: A school having classes up to standard X only.

School - Higher Secondary/ +2/ Intermediate: A school having classes up to standard XI or XII only.

Seasonal Diagramming: By major season or by month to show days and distribution of crops, agricultural labour, non-agricultural labour, animal fodder, fuel, migration, etc.

Secondary Sources: These include files, reports, maps, aerial photographs, satellite imagery, articles, journals, and books.

Seeking or Available for Work (or unemployed): Persons who owing to lack of work have not worked but have either sought work through employment exchanges, intermediaries, friends or relatives or by making applications to prospective employers or expressed their willingness or availability for work *under the prevailing conditions of work and remuneration* are considered as those who are 'seeking or available for work' (or unemployed). *(Source: NSSO)*

Self-Cultivation: Self-employed in cultivation.

Self-employed: Persons who are engaged in their own farm or non-farm enterprises or are engaged independently in a profession or trade on own account or with one or a few partners are deemed to be self-employed in household enterprises. The essential feature of the self-employed is that they have autonomy and economic independence for carrying out their operation. Self-employed persons are categorised as follows:

(i) *Own-account workers:* Self-employed persons who operate their enterprises on their own account or with one or a few partners and who, by and large, run their

enterprises without hiring any labour. They may, however, have unpaid helpers to assist them in the activity of the enterprise;

(ii) *Employers:* Self-employed persons who work on their own account or with one or a few partners and, who, by and large, run their enterprises by hiring labour; and

(iii) *Helpers in household enterprise:* Self-employed persons (mostly family members) who are engaged in their household enterprises, working full or part-time and do not receive any regular salary or wages in return for the work performed. They do not run the household enterprise on their own but assist the related person living in the same household in running the household enterprise. *(Source: NSSO)*

Self-employed in Non-agricultural and Allied Activities: Workers classified under this category are self-employed in economic activities excluding agriculture, hunting, forestry and fishing. *(Source: NSSO)*

Semi-pucca House: House built with burnt bricks, stone, concrete materials, but the roof covered with tiles.

Semi-structured Interview: It is an exercise having a mental or written checklist, but being open-ended and following up on the unexpected using participatory visuals as well as traditional verbal methods i.e. through interaction.

Short Run: The time period in the production process during which the fixed factors of production cannot be changed, but the level of utilisation of variable factors can be altered.

Simple Random Sampling: Sampling at random without replacement of sample units between the draws.

Small Business and Trade (Unorganised Sector Enterprise): It refers to those enterprises which are not registered under the Factory Act 1948.

Social Capital: The social capital of a society includes the institutions, relationships, attitudes and values that govern interactions among people and contribute to economic and social development. It includes the shared values and rules for social conduct expressed in personal relationships, trust and a common sense of 'civic' responsibility, that makes a society more than a collection of individuals.

Social Cost: It is the opportunity cost to society as a whole rather than just to one firm or individual. It differs from the private cost since it includes costs of externalities.

Social Mapping: Social mapping is a type of space-related PRA method and explores the spatial dimensions of people's realities. It helps in depicting the habitation patterns and the nature of housing and social infrastructure: roads, drainage system, schools, drinking water facilities, etc. A social map is different from other maps as it is made by local people and not by experts. It is not drawn to scale. It depicts what the local people believe to be relevant and important for them. It reflects their perceptions of the social dimensions of their reality with a high degree of authenticity.

Stakeholders*:* Include all individuals and/or groups who are affected by, or can affect, a given operation. Stakeholders can be individuals, interest groups, corporate organisations.

Standard Deviation: It is the measure of the dispersion of a series around the mean value.

Standard Error: It is the standard deviation of the values of a given function of the data (parameter) over all possible samples of the same size.

Standard Normal Variate: A variable (a set of data) that has normal distribution with mean = 0 and standard deviation = 1 is known as standard normal variate.

State Highways (SH): These are the arterial roads in a state for inter-district movements. They traverse the length and width of a state connecting the state capital, district headquarters and important towns and cities and link up with the national highways and adjacent state highways.

Statistic: A number that can be computed from data, involving no unknown parameters. As a function of a random sample, a statistic is a random variable. Statistics are used to estimate parameters and to test hypotheses.

Statistically Significant: A finding (for example, the observed difference between the means of two random samples) is described as statistically significant, when it can be demonstrated that the probability of obtaining such a difference by chance only, is relatively low.

Stratified Random Sampling: Sampling at random from each of the stratum or subgroup of a population.

Stratified Sampling: Sampling from each stratum or subgroup of a population.

Subsidiary Economic Activity Status*:* A person whose principal usual status is determined on the basis of the major time criterion may have pursued some economic activity for a relatively shorter time (minor time) during the reference period of 365 days preceding the date of survey. The status in which such economic activity is pursued is the subsidiary economic activity status of the person. In case of multiple subsidiary economic activities, the major two activities and their statuses based on the relatively long time spent criterion is considered. The engagement in work in subsidiary capacity may arise out of the following two situations:

(i) a person may be engaged for a relatively long period during the last 365 days in economic/non-economic activity and for a relatively short period in another economic activity; and

(ii) a person may be pursuing one economic activity/non-economic activity almost throughout the year in the principal usual activity status and also simultaneously pursuing another economic activity for a relatively short period in a subsidiary capacity *(Source: NSSO)*.

Supply: The quantity of goods or services available for sale at any specified price.

Survey Code: It shows whether the originally selected sample household has been surveyed or a substituted household has been surveyed.

Tehsil: A unit constituted at sub-district level for the purpose of revenue administration.

Thatched House: House built with grass, leaves, bamboo, wood, and mud.

Time Line: Chronologies of events, listing major remembered events in a village with approximate dates.

Total Cost: The total cost of producing any given level of output. In the short run, total cost can be divided into two parts: fixed cost, that is, those costs which don't vary with output and variable cost, that is, those costs which vary directly with output. In the short run, output can only be changed by adjustment of the variable factor inputs. Thus the addition to total cost from any increase in output is given by the cost of the extra variable inputs required. In the long run, all factors are variable.

Track: A path on the land much trodden by persons and animals.

Trading: The commercial exchange (buying and selling on domestic or international markets) of goods and services. This includes both wholesale and retail trade.

Transit Walks: Systematically walking with informants through an area, observing, asking, listening, discussing, identifying different zones, local technologies, introduced technologies; seeking problems, solutions and opportunities; and mapping and diagramming resources and findings.

Trip: It is a one-way person movement by any mode of transport having two trip ends, an origin or start of a trip and a destination or end of a trip for a specific purpose.

Trip Distance*:* It is the distance of one-way person movement between origin and destination.

Trip Purpose: It is the purpose of the one-way person movement. A trip may be made for any purpose like work, education, business, shopping, etc.

Trip Time: It is the time taken to complete one-way person movement between origin and destination.

Unemployed: *See 'Seeking or Available for Work'.*

Unit: A member of a population.

Urban Area: All places with a municipality, corporation or cantonment or notified town area and all other places which satisfy the following criteria:

(i) minimum population of 5,000;
(ii) at least 75 percent of male working non-agricultural population; and
(iii) a density of population of at least 400 per square km.

Usual Activity Status*:* It relates to the activity status of a person during the reference period of 365 days preceding the date of survey. The activity status on which a person spent relatively longer time (major time criterion) during the 365 days preceding the date of survey is considered the *principal usual activity status* of the person. To decide the principal usual activity of a person, he/she is first categorised as either belonging to the labour force or not belonging to the labour force, during the reference period on the basis of major time criterion. Persons thus adjudged as not belonging to the labour force, are assigned the broad activity status 'neither working nor available for work'. For the persons belonging to the labour force, the broad activity status of either 'working' or 'not working but seeking and/or available for work' is ascertained again on the basis of the relatively longer time spent in the labour force during the 365 days preceding the date of survey. Within the broad activity status so determined, the detailed activity status category of a person pursuing more than one such activity will be determined again on the basis of the relatively longer time spent. *(Source: NSSO)*

Variance: A measure of the dispersion of a distribution from the mean. The variance of a series is the square of the standard deviation of the series, i.e. the average of the squares of the deviations of the numbers in the series from their mean.

Vehicle: A conveyance that transports people or objects.

Village: It is the smallest unit of habitation in rural areas and generally follows the limits laid down for a revenue village. The revenue village need not necessarily be a single agglomeration of habitation *(Source: Census of India*).

Village Roads (VR): These roads pass through rural areas, connecting villages to one another and serve as the feeder roads for the district roads, state highways, national highways, railways or river ghats.

Wage Paid Manual Labour*:* A person who does manual work in return for wages in cash or kind or partly in cash and partly in kind (excluding exchange labour) is a wage paid manual labour. Salaries are also counted as wages. A person who is self-employed in manual work is not treated as a wage paid manual labour *(Source: NSSO).*

Wage/Salaried Employees: An occupation category covering employees working for regular salary or wage.

Wealth Ranking or Well-being Ranking: A method commonly used for ranking and grouping households and communities on the basis of income and wealth, and other perceivable well-being criteria. Wealth ranking is a tool that helps to better understand socio-economic differences within a community. Well-being ranking is based on the perception of the local people.

Worker(s) (or Employed): Persons who are engaged in any economic activity or who, despite their attachment to economic activity, have abstained from work for reasons of illness, injury or other physical disability, bad weather, festivals, social or religious functions or other contingencies necessitating temporary absence from work. Unpaid helpers who assist in the operation of an economic activity in the household and farm or non-farm activities are also considered as workers. All workers are assigned one of the detailed activity statuses under the broad activity category 'working or being engaged in economic activity' (or employed) *(Source: NSSO).*

Worker: A 'worker' is a person who mainly participates in an economically productive activity either physically or mentally. Work includes not only involves actual work but effective supervision and direction of work as well. *(Source: Census of India).*

Workforce Participation Rate (WFPR): The number of persons/person-days employed per thousand persons/person-days is referred to as workforce participation rate (WFPR) or worker – population ratio (WPR). *(Source: NSSO)*

Zilla Parishad/District Council: It is the topmost tier with its territorial area congruous with an administrative district.

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