IDFC INSTITUTE

Developing Infrastructure to Create Employment

Case Study: Water Provisioning in Punjab

Vaidehi Tandel, Harshita Agrawal, Prakhar Misra and Sharmadha Srinivasan

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Abstract

This case study is a supplement to the 2019 IDFC Institute report titled *Infrastructure Priorities for Job Creation in India*, which focused on the type of physical infrastructure needed in a given economic geography to boost job creation. This case study is meant to be an overview of the considerations taken into account by government officials while determining where to supply water and estimating costs for infrastructure provision and maintenance. It uses empirical analysis for descriptive purposes rather than for explaining or determining causation. Our study finds that the mandate of existing departments is to cater to household demand for water supply and ensure adequate provision of drinking water. In addition to the need to implement schemes created for improving service delivery of water supply to households, political and equity considerations drive water provision priorities.

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1. Introduction

This case study is a supplement to the 2019 IDFC Institute report titled *Infrastructure Priorities for Job Creation in India*, which focused on the type of physical infrastructure needed in a given economic geography to boost job creation. The report aimed to add a new method to policymakers' toolkits for identifying gaps in infrastructure provision. This would help guide infrastructure investment decisions. We argued that decision making on infrastructure priorities must take into account the multiplier effect on economic growth, particularly employment.

In order to illustrate the employment effects of infrastructure, we undertook an extensive survey of 2,500 firms in the agro-allied, industrial and services sectors in 18 districts. We asked firms about the main physical infrastructural bottlenecks they were facing in expanding their operations. We then estimated the savings that would accrue to these firms if these issues were resolved. We calculated the employment effects if firms reinvested these savings in capital. Our results suggested that connectivity through roads would have the largest impact in terms of job creation due to capital saved, followed by providing electricity and water supply.

The next step is to understand the following: 1. determinants for prioritising infrastructure projects to examine whether factors like potential employment created from bridging the infrastructure gap are considered while planning for provision; 2. cost of infrastructure provision to estimate what bridging the infrastructure deficit would cost the government. Given the federal set-up, responsibilities and powers with respect to infrastructure provision are divided between the centre and states. State governments plan and implement infrastructure projects through their departments and parastatals. This makes it necessary to study decision making at the state level.

In this case study, we focus on one particular physical infrastructure type — the provision of water supply — in the state of Punjab, which had two of the 18 selected districts in our primary study viz. Amritsar and Ludhiana. The key determinant in providing infrastructure is the cost involved in construction and operation. We look at the water supply provisioning in Punjab to answer the following questions:

- What are the non-budgetary and budgetary aspects of decision making with respect to providing water supply?

- How are the costs estimated by bureaucrats and public officials?
- What are the key challenges in terms of cost of provision?
- Who pays for the infrastructure and how is the cost burden distributed?

Our analysis is based on secondary data (including cost estimates), as well as extensive interviews with officials from the Department of Water Supply and Sanitation (DWSS) and Punjab Water Supply and Sewerage Board (PWSSB). We visited Punjab in early 2020 and interviewed central and state cadre officials in charge of overseeing water provisioning in Punjab to understand challenges in estimating infrastructure costs. Based on our discussions, the study takes a bird's-eye view of the costing procedures in Punjab while relying on evidence and data from the ground.

The study is structured in five sections including the introduction. The second section details the current water supply situation in Punjab and existing schemes for improving it. The third briefly outlines some of the non-budgetary considerations in determining infrastructure provision priorities and discusses the key determinants of the cost of provision. The fourth looks at the cost incidence in water supply provisioning. The last section concludes the paper.

This case study is meant to be an overview of the considerations taken into account by government officials while determining where to supply water and estimating costs for infrastructure provision and maintenance. It uses some empirical analysis for descriptive purposes rather than for explaining or determining causation. The main objective is to inform the reader about how decisions around infrastructure provision — which holds the potential to create employment opportunities in the region — are shaped by budgetary mandates, demand-side factors and cost considerations.

2. Background of Water Supply Provisioning

The state of Punjab has a population of 27.7 million according to the last census, conducted in 2011. The urban population is 10.39 million, making it a largely rural state. Punjab's economy is predominantly focused on agriculture compared to other states in India, with the sector contributing to nearly 27% of the state Gross Value Added (GVA). The state has considerable importance in the country's agricultural output. Administratively, Punjab is divided into 22

districts. Much of the governance set-up is based on the rural-urban distinction and is also organised at the district level.

With three perennial rivers viz. Beas, Satluj, and Ghaggar, high groundwater tables, and a network of canals, the state is considered to have sufficient water resources. However, there is considerable variation within the state. At present, there are 140 dark blocks, that is, blocks without any groundwater. Parts of the hilly and high-altitude areas, known as the Kandi belt, are barren and have insufficient water supply. Moreover, in recent times groundwater tables in various parts of the state are being depleted due to indiscriminate use of tubewells to pump water for cultivating water-intensive crops like rice paddy.

In terms of governance, there are separate authorities that are responsible for providing and maintaining water supply and sanitation in the urban and rural areas. These authorities are also responsible for implementing the different water supply schemes instituted by the central government and the government of Punjab.

2.1 Institutions Governing Water Supply Provisioning

The Department of Water Supply and Sanitation (DWSS) has been the main state government department in charge of water supply provision in rural areas since 2004. It provides safe drinking water to the rural population and manages sanitation and sewerage systems — currently operationalised through the World Bank-funded Rural Water Supply and Sanitation Project. The department also implements the Swachh Bharat Abhiyan, which was launched by the Government of India in 2015. At the local level, rural local bodies or gram panchayats are in charge of managing village projects for water supply and sanitation. At present, 50% of the state's rural population has access to drinking water.

For areas governed by Urban Local Bodies (ULBs), two kinds of governance arrangements exist. The Punjab Water Supply and Sewerage Board (PWSSB) was created under the Punjab Water Supply and Sewerage Act 1976. Administratively, the PWSSB is under the Department of Local Government. The Board's broad mandate is to implement projects as well as provide for operations and maintenance (O&M) of water supply and sanitation systems in urban areas. According to its website, "The Board largely works for putting in place urban water supply

systems, sewerage schemes and sewerage treatment plants (STPs) as well as operational management water supply schemes, sewerage schemes and STPs in various towns of Punjab. In this area the main function of the Board is to prepare, execute, promote and finance the schemes for supply of water for drinking purposes and sewerage schemes for disposal of domestic sewerage." It currently serves 59 out of the 167 urban local bodies. The other ULBs have made their own water utilities for providing and maintaining drinking water supply and sewerage systems. The Department of Industries is responsible for providing water supply and wastewater treatment for enterprises in industrial areas.

2.2 Existing Schemes for Water Supply Provisioning

Meeting the targets under different water supply schemes and implementing them successfully are key priorities for the departments. Hence, such schemes determine budgetary allocations and where and how infrastructure is provided. In this section, we outline three major schemes for water supply provision.

2.2.1. Punjab Rural Water Supply and Sanitation - Sector-wide Approach Model

In Punjab, rural water supply has traditionally been provided by the state government with villages having a few handpumps, piped schemes and so on. However, this was nowhere near adequate. In 2006, the Government of Punjab partnered with the World Bank to transform rural water supply across 15,000 villages with funding of Rs. 985 crores. The goal was to build infrastructure i.e. pipelines that would supply water 24x7, and then hand them over to communities to own, operate and manage, with support from the DWSS. An additional aim of the project was to make the systems financially sustainable, with operation and maintenance charges being recovered through user tariffs. By the end of the project in 2014, water supply improved in 1,452 villages. Across the scheme, 74% of villages fully meet the costs of operation and maintenance.

2.2.2. Jal Jeevan Mission

Rural water supply has been a priority for the central government since 1970, when it launched the Accelerated Rural Water Supply Programme. In 2009, the Accelerated Rural Water Supply Programme was renamed as National Rural Drinking Water Programme (NRDWP), which is a

centrally sponsored scheme with funding shared between the centre and states. The objective was to enable access to safe and adequate drinking water for all households within the house by 2030.

The NRDWP has now been subsumed into the Jal Jeevan Mission (JJM) which was launched in August 2019. It aims to provide Functional Household Tap Connection (FHTC) to every rural household i.e., Har Ghar Nal Se Jal (HGNSJ) by 2024, with a service level at the rate of 55 litres per capita per day. JJM also will focus on local infrastructure development for creating sustainable sources of water like rainwater harvesting, groundwater recharge and management of household wastewater for reuse, in convergence with existing government programmes and schemes.

The total estimated cost of JJM is Rs. 3.60 lakh crore. The funding will be shared between the centre and states. The pattern is 90:10 for Himalayan (Uttarakhand, Himachal Pradesh) and North-Eastern states, 100:0 for Union Territories and 50:50 for the rest of the states.

Before the launch of JJM, as on 1 April 2019, 53.23% of the total number of households in rural Punjab i.e. 17,57,459 households had tap connections. That number has gone up to 18,30,786 households with a coverage of 55.45% households, as on 15 May 2020.

2.2.3. Atal Mission for Rejuvenation and Urban Transformation (AMRUT)

AMRUT, launched on 25 June 2015, stemmed from prioritising basic services like water supply, sewerage, urban transport and so on to households in cities. However, developing the infrastructure is not enough. This infrastructure must be used to provide these services. Therefore, AMRUT's purpose is to ensure basic infrastructure services to provide water supply, sewerage, storm water drains, urban transportation and green spaces.

With respect to the water supply component, the provisions to be made are as follows:

i. Water supply systems including augmentation of existing water supply, water treatment plants and universal metering.

ii. Rehabilitation of old water supply systems, including treatment plants.

iii. Rejuvenation of water bodies specifically for drinking water supply and recharging of groundwater.

iv. Special water supply arrangement for difficult areas, hill and coastal cities, including those having water quality problems (e.g. arsenic, fluoride).

The centre will provide assistance of 30% of the project cost to cities with a population of above 10 lakh and 50% to cities with a population of up to 10 lakh. The remaining costs are to be borne by state governments, urban local bodies or private investors.

The total investment for water supply projects in 16 cities in Punjab for the period of the mission, 2015-2020, is Rs. 1,050.81 crore.

3. Determining Cost of Water Supply Provision

Before estimating costs, we outline non-cost related considerations in deciding where and how the water supply is provided. These are hard to measure empirically but are more broadly situated in the political and equity aspects of decision making. The cost of provisioning becomes subservient to these factors. We flag three such factors below:

- Demand-driven needs: In urban areas, water supply needs are assessed based on broad surveys of citizens and estimations conducted by the PWSSB. In rural areas, the government department estimates demand based on a village or group of villages collectively expressing the need for water supply.
- Political factors: Local elected officials may request the department to improve and increase water supply provision within their constituencies.
- Underdeveloped regions: The DWSS has to ensure adequate water supply provision in areas that do not have adequate groundwater as well as in the Kandi belt region.

The water supply provision cost is broadly divided into construction cost, and operations and maintenance costs. The former includes one-time fixed and variable costs involved in creating the infrastructure while the latter includes recurring costs such as the cost for operating the water pumps, or the cost of maintaining pumps, treatment units, and so on. The construction cost varies with the size and capacity of the project. The following parameters are considered before determining this:

- Projected population to be served for the next 30 years. This is to estimate the total water demand. Population projections are made at the village level by the DWSS using estimation methods outlined in the World Bank's Technical Manual.
- Per capita water supply rate in litres per capita per day (lpcd). For domestic use in rural areas, the World Bank's Technical Manual considers this to be 70 lpcd.
- Source, storage, and nature of treatment of water
- Life of the infrastructure in terms of number of years
- Parameters pertaining to the distribution network
- Type of pumps (depends upon the source water supply ie. groundwater or surface water)
- Topology of region

The estimated cost of construction of a water supply project has to take into account the above parameters. We look at the two broad components in the sub-sections below.

3.1 Construction cost[1]

Most of the parameters outlined earlier directly impact the cost of construction. The DWSS uses well-known costing methods for various components based on per capita provision. Cost of labour used in construction, that is, wages, is determined by the Labour Bureau and differs for skilled, semi-skilled and unskilled workers. The cost may also vary by district or municipal corporation. All materials required for construction are classified as scheduled items and non-scheduled items. For the former, the cost is published in the commercial schedule of rates. For the latter, the cost is determined based on market rates.

It should be evident that the construction cost is directly related to the number of people that the water supply project is meant to serve. Besides this, an important factor for variation in project cost is the source of water. For instance, when the source of water is groundwater, costs are relatively low as compared to surface water from canals. However, the cost of drilling for groundwater varies according to the topography of specific blocks. The average per capita cost of drilling tube wells is around Rs. 1000 but can rise to as high as Rs. 7000 in hilly areas. If surface water is to be used, there could be additional costs of treating the water and, if needed, of

[1] Hard data on project construction costs were not available. We relied on interviews with government officials for information pertaining to factors affect costs in construction.

building boundary walls to prevent wildlife and other livestock from accessing the water. Drilling tube wells in the dark blocks is not permitted by the Central Ground Water Board. These areas have to rely on surface water, which is more expensive to supply.

There are other coordination issues with respect to surface water drawn from canals, since these are managed by the Department of Agriculture. Other factors, such as the specific process of purification required to rid the water of various impurities and the dimensions of the pipe, also have a bearing on the construction cost.

3.2 Operations and maintenance cost

The major operations and maintenance costs involve repair costs, costs for cleaning water tanks and canals, cost of consumables such as grease, oil and diesel, wage costs, and electricity costs of running the motors. There are also certain costs associated with billing and collection of payments from households.

Table 1 provides the share of major O&M expenditures in the total expenditures incurred by PWSSB in the financial year 2019-20.

Table 1. PWSSB actual expenditures on O&M

Expenditure component	Amount (in Rs. Million)	Share in total expenditure (%)
Wages	399.1	61.1
Electricity	145.7	22.3
Repairs	53.5	8.2
Speical repairs	2.5	0.4
Consumables	24.7	3.8
Others	27.1	4.2
Total	652.6	100.0

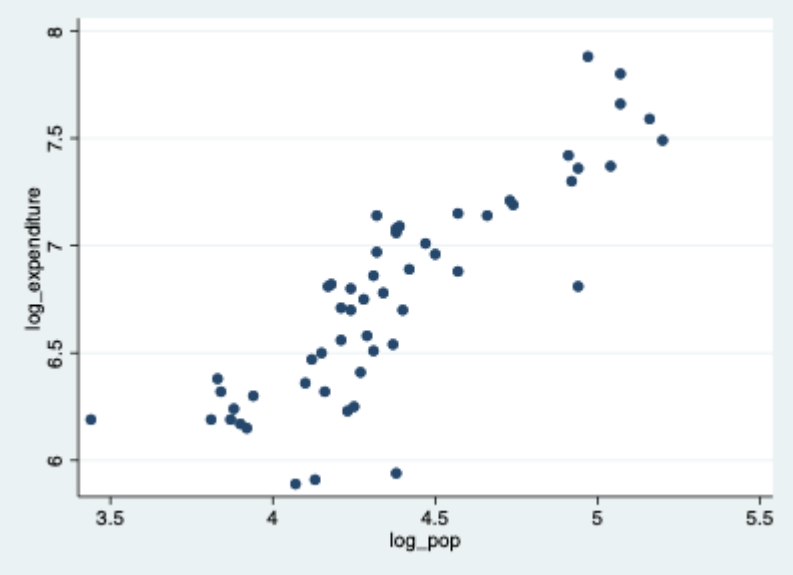
Source: Punjab Water Supply and Sewerage Board

Wage costs and electricity costs form the highest components of O&M and recurring costs. High electricity costs are attributed to the fact that the tariffs charged for supplying drinking water are on par with tariffs for industrial use (which are the highest rates). Electricity for using water for irrigation is provided free of charge. Further, the high share of wages and electricity in the total O&M costs does not seem to be unique to Punjab. In a study of project costs for water supply provided by urban local bodies in Andhra Pradesh, Nallathiga (2012) finds that the two

components make up 75% of the total O&M costs, with salaries forming the largest component. On average, salaries or wages make up 33% of total O&M costs in Andhra Pradesh (as against 61% in Punjab) and electricity makes up 44% on average of total O&M costs (as compared to 22% in Punjab). The average per capita O&M expenditure in Punjab is Rs. 287, and it ranges from Rs. 37 to Rs. 824.

ULB population is a key determinant of expenditures on O&M. Figure 1 presents a scatter plot that shows the tight positive correlation.

Figure 1. Relationship between O&M expenditure and population



Appendix A provides results from an OLS regression with log expenditure as the outcome variable and log population as the main dependent variable. We find that a 1% change in population will lead to a 1.1% increase in O&M expenditure and that 72% of the variation in such expenditure is possibly due to the variation in population across urban local bodies.

4. Cost Incidence of Water Supply Provisioning

Who bears the cost of the infrastructure varies depending on the schemes. Typically, the cost of projects is recovered through water supply charges and grants from the central government for specific schemes.

In rural areas, under the Jal Jeevan Mission, communities in villages are expected to contribute towards the cost of running the drinking water supply project and provide up to 10% of the capital cost of the project. At the planning stage, an amount of Rs. 800 per household and Rs. 400 per SC/ST household is collected from the community towards the project. The DWSS charges a flat rate of Rs. 150 per household to pay for water supply. Water use above a certain limit is supposed to be charged based on the amount of volumetric consumption. There is no separate tariff for commercial use of water in these areas. Village communities are expected to maintain and run the project based on these collections. However, because water metering is inconsistent, accurate usage cannot be measured and collections stay low. Low collections combined with high electricity costs for running the water meters mean that revenues do not cover the total O&M costs.

In urban areas, large municipal bodies that manage their own systems are supposed to ring fence revenues to pay for operating the drinking water supply system. For ULBs under the PWSSB, the former are supposed to pay for the costs incurred by the Board in providing services like operations and maintenance. However, the Board has no enforcement mechanism to ensure that ULBs pay the dues and arrears. This has resulted in instances where, instead of clearing their dues, ULBs left the Board to set up their own water supply systems.

Until January 2020, Punjab did not have a regulatory authority to determine uniform charges and tariffs across the states based on consumption and use. As a result, tariff structures and rates were determined independently at the local level and there was no check on the potential misuse of this power for political ends. With the passing of the Punjab Water Resources (Management and Regulation) Bill, 2020, a Water Regulatory Authority will be set up in the state in order to standardise and enforce a clear tariff structure and differentiate rates based on commercial, domestic and industrial use.

5. Conclusion

Infrastructure investment is one of the conduits through which governments can catalyse growth and thereby create employment. Non-household demand is a function of existing levels of infrastructure, and the type of economic and population growth in the region. Three factors determine whether governments are able to respond to this demand — decision-making

priorities, cost of provision and cost recovery. At the outset, we wanted to investigate two important questions in this regard viz. how do governments set out priorities in infrastructure provision (and whether jobs created from meeting demand from the non-agricultural sector is one of these priorities) and how do we estimate cost of infrastructure provision (to know what incremental provision of infrastructure would cost the government). While we were able to satisfactorily answer the first question, due to lack of adequate data, we limited our analysis of the second question to outlining the types of costs and magnitude of operations and maintenance costs.

Our study finds that the mandate of existing departments is to cater to household demand for water supply and ensure adequate provision of drinking water. In addition to the need to implement schemes created for improving service delivery of water supply to households, political and equity considerations drive water provision priorities. In terms of non-household use of water, water supply for agriculture and irrigation is the biggest priority. Thus, ensuring adequate water supply for non-agricultural non-household needs, that is, for services and manufacturing, becomes a residual function. Firms end up making their own arrangements, such as digging borewells, in order to get water supply unless they are in designated industrial areas. In our previous report, a number of these firms cited inadequate water supply as a constraint to their operation and growth.

In terms of cost of provision, we find that construction costs depend on a number of factors including the source of water, number of households to be provided for, and water treatment. There are established methods used by government officials to estimate these costs when water supply infrastructure needs to be created. The key challenge with respect to operations and maintenance of the water supply infrastructure is in terms of cost recovery. Often, these costs are greater than what officials estimate mainly due to the high charges for using electricity and high wage costs. Cost recovery is an issue due to inadequate revenue collections from water charges and the inability to take action for non-payment of arrears. These factors, which largely exist in the provision of drinking water supply, could potentially be a detriment in meeting water supply needs of firms.

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Appendices

Appendix A

Table 2. Regression results

VARIABLES	log expenditure
log population	1.074***
	(0.0913)
Constant	2.067***
	(0.401)
Observations	55

R-squared	0.723

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1