Assessment of employment generation potentials of Jal Jeevan Mission

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Special thanks to the

International Labour Organization

August 2023

Abstract

Launched in 2019, the Jal Jeevan Mission (JJM) aims at providing Functional Household Tap Connection (FHTC) to every rural household in the country, with the provision of 55 litres per capita per day (lpcd). Since 2019 when coverage of rural household was only 16.63%, the mission has managed to cover about 2/3rd of rural households so far. One of the distinct features of the mission is that it lays emphasis on service delivery rather than only creation of infrastructure. Moreover, with the large amount of investments being made in infrastructure development and the involvement of local community in its management, the mission holds significant potential in creating employment in various phases of its implementation. So far, there are hardly any studies conducted on the extent of employment generation under the government funded water supply schemes. In this backdrop, this study aims to assess the employment generation potentials of JJM at various stages of its implementation. We utilized secondary data and scheme level primary data from major states of India and used input-output model and ratio method to assess the overall, as well as the direct and indirect employment potential, under JJM. Our results suggest that JJM has the potential to generate an average of 59,93,154 person-year of direct and 2,22,55,324 person-year of indirect employment during the construction phase, and 11,18,749 person-year of additional direct employment annually during the O&M stage. Our study highlights these spillover effects of public investments in rural water supply systems in the form of employment generation.

Keywords: *Jal Jeevan Mission, employment generation potential, drinking water supply*

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1. Introduction

The year 2019 was a watershed year in the history of drinking water supply in rural India with the launch of Jal Jeevan Mission (JJM). The mission aims at providing individual household tap water connection to every household with the provision of 55 litres per capita daily (lpcd). Since its launch in 2019 when the coverage of rural households was 16.63%, the mission has managed to cover 2/3rd of rural households in the country. The mission aims to provide regular supply of adequate quantity of quality water to prevent deaths and illness due to water borne diseases, eliminate drudgery in accessing drinking water, and improve health and productivity of people in rural areas. One of the distinct features of the mission is that it focuses more on service delivery rather than just creating infrastructure. Moreover, with the scope of decentralized governance and a greater community engagement, the mission holds significant potential of spillover effect in generating employment in various phases of its implementation apart from providing adequate quantity of quality water to rural households.

The creation of any public infrastructure generally has direct, indirect, and induced effects on employment (Nourelfath, Lababidi, & Aldowaisan, 2022). The direct impact includes the employment generated during the construction and O&M (Operations & Maintenance) phases of an infrastructure project. For instance, under JJM, the creation of infrastructure such as Functional Household Tap Connections (FHTCs), water storage tank, and treatment plant provides employment in laying pipes and other construction activities, whereas other skilled workers such as engineers, valve men, pump operators, and managerial staffs are employed for proper execution of planned schemes. Similarly, the O&M of the scheme also requires several skilled workers such as waterman, pump/valve operator, supervisor, watchman, etc. to regularly inspect infrastructure and ensure uninterrupted service delivery. While the construction stage generates one time employment, the employment generated at the O&M stage is perpetual. Further, the indirect employment generated during the production, storage, and transportation stages of materials used at the construction as well as O&M stages and in the production of inputs used in those materials, is likely to be substantial.

Investment in infrastructure has a positive effect on job creation in every future time period compared to an earlier time period (Bennett, 2019). In the construction phase of JJM, tenders are awarded to private entities to ensure the completion of infrastructure creation within stipulated timelines. After the construction phase, a part of Multi-Village Schemes is centrally managed under the state departments but are often contracted out to the private entities under five-year agreements (Government of India, 2019). The operations and maintenance of water supply schemes, when locally managed, creates jobs at the lowest economic level where unemployment tends to be high with lower skill levels (Wall, 2023). So far, literature provides sparse evidence on how quality drinking water facilities would lead to better health and higher labor supply and productivity (Asit, Ramani, & Cecilia, 2005; Devoto, Duflo, Dupas, Parienté, & Pons, 2012; Kremer, Leino, Miguel, & Zwane, 2011), and there is real need of studies assessing spillover effect of any public water supply schemes on employment generation. Keeping in mind existing literature, this study aims to estimate the level of employment potentially being generated under JJM.

1.1. Types and nature of schemes under JJM

As per JJM operational guidelines the following types of schemes can be implemented depending on factors such as geographical terrain, population density, availability of water sources, and the feasibility of infrastructure implementation in a specific region:

Single Village Scheme (SVS)

SVS are planned and implemented targeting a single village or a cluster of habitations making a single village having adequate groundwater/ spring water/ local or surface water source of prescribed quality identified within or nearby the village boundaries.

Multi Village Scheme (MVS)

As the name suggests, an MVS comprises a cluster of villages and aims to optimize resources and infrastructure by serving multiple villages/habitations with a single water supply system. MVSs are planned where villages do not have nearby sustainable source (ground/surface) or available ground water source is contaminated. In this case, an alternative source is identified nearby and planned in a way that supplies water to all enroute villages.

In-Village Distribution System (IVDS)

IVDS also known as in-village PWS (Piped Water Supply), refers to the network of pipelines, storage facilities, and distribution points that are established to ensure the supply of piped water to individual households within a village. The IVDS schemes include the laying of pipeline and tap connections for which the water is mostly sourced from an MVS.

Each of the above types of schemes is implemented in two different phases i.e., construction and O&M. The construction of schemes takes approximately 12 to 18 months for IVDSs and SVSs, and 24 to 36 months for MVSs. Post construction, MVSs are operated and maintained by the contractors (with contracts renewable every 5 years), while SVSs are handed over to the community (Gram Panchayat) after a mutually decided tenure of O&M (may vary from state to state).

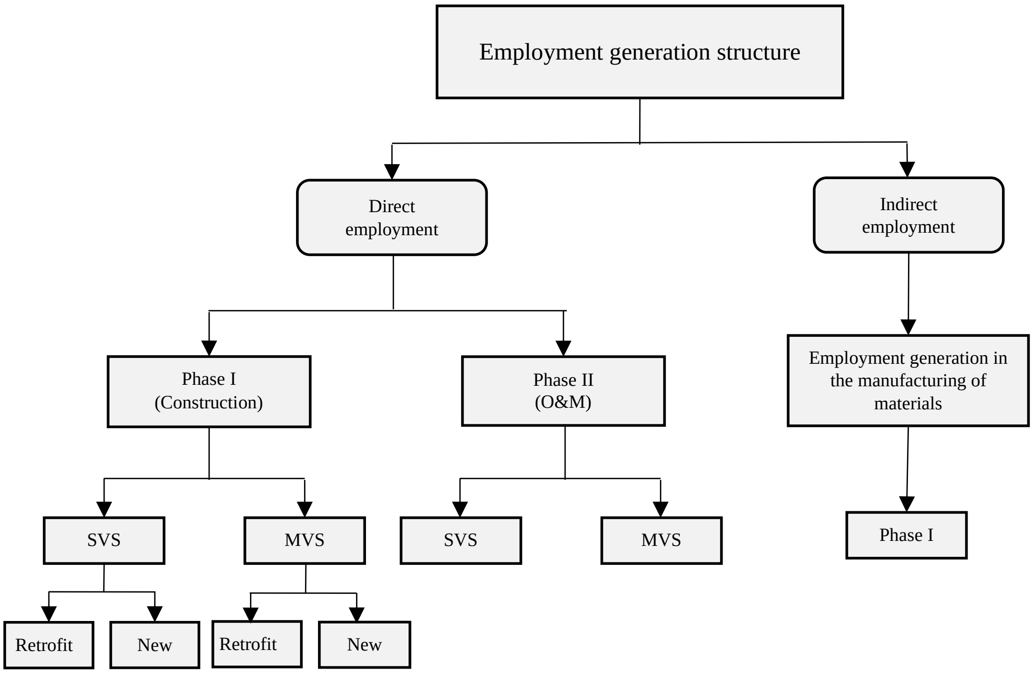
Apart from the above categorization of schemes, the nature of construction of schemes can be different such as: i) a scheme can be completely new provided the village had no water supply facility/infrastructure in the past, ii) in case a village has existing piped water supply system (PWS), but it is supplying water through stand post or water quantity is less than 55 lpcd, it can be retrofitted /renovated to provide Functional Household Tap connection (FHTC) within household premises by extending existing water supply line. If required, the source is strengthened/ augmented to meet future water demand.

1.2. Structure of employment generation under JJM

JJM helps to generate both direct and indirect employment in its two phases: construction and O&M. The employment generated during the construction phase is expected to be larger than the employment needed for annual O&M. However, this may not hold true in the long-run as the employment generated at the construction phase is one-time and depends upon various factors such as scheme size, nature of the scheme (retrofit/new), availability of manpower and topographic conditions, whereas employment at O&M phase is more likely to be permanent. Again, in each of these phases, employment generated may vary based on the type of scheme (MVS or SVS) and nature of the scheme (retrofitted or newly constructed). Indirect employment is generated in the production, storage, transportation, and distribution of materials directly or indirectly needed for JJM. Direct materials are pipes, valves, meters, construction materials, etc. whereas indirect materials are steel, and other raw materials that go into making pipes, valves, meters, etc. These requirements at the construction as well as O&M

phases need to be assessed, and the total employment generated can be thus estimated. The conceptual structure of employment generated is given in Figure 1.

Figure 1. Structure of employment generation under JJM.



Note: i) Authors' depiction, ii) MVS: Multi Village Scheme, iii) SVS: Single Village Schemes

2. Objectives

This study aims to assess the employment generation potential in the construction and operation maintenance of JJM. Specifically, the objectives are:

1. To estimate the total employment generated in the construction phase.
2. To estimate the direct and indirect employment generated in the construction phase.
3. To estimate the direct employment generated in the O&M phase.

3. Methodology

3.1 Study framework

This study estimates employment potentials under JJM using mainly two different methods. First, we utilize the input-output (IO) model to estimate the total employment potential during the construction phase. Further, using the ratio method, we estimate the direct employment potential at different phases of implementation of JJM utilizing scheme level data from various representative states. We also estimate partial indirect employment generated during the construction phase which involves production, storage, and transportation of direct material by employing ratio method. We did not attempt to compute the indirect employment created during O&M phase as it is likely to be small. We also did not attempt compute the induced employment generated by JJM in this study as it requires household data.

The motivation of the study is to bring forth a national level assessment of one-time construction phase and long-term O&M phase employment generation under JJM. To make this study nationally representative, we use data from many states spread throughout the country and we estimate the employment potential of other states by grouping them with the states from where we received the data, through cluster analysis utilizing data on factors that are likely to impact employment in drinking water supply schemes.

3.2. Analytical tools

We employ two major analytical tools: an IO model to understand the level of total (direct and indirect) employment generated at the national level, and ratio method to estimate the direct and a part of the indirect employment potential generated at the national and various state level.

3.2.1. Leontief Input-Output Model

The Leontief input-output model is utilized to estimate the total employment which includes direct and indirect employment generation during construction phase. This method helps estimate the overall employment more comprehensively than the ratio method. In this study, we use the input output model as used by Garrett-Peltier (Garrett-Peltier, 2017) in estimating the impact of additional investments in the renewable energy industry on employment. In this method, the total output of an industry can be expressed as:

$$X=Y+AX \qquad (1)$$

Where X is the total output, Y is the final demand and A is the IO matrix for the economy. AX gives the output produced by different industries which is used as input in the production process in other industries. This equation can be simplified to obtain the total output of any industry as below:

$$X = (I-A)^{-1} Y$$

Thus, $\Delta X = (I-A)^{-1} \Delta Y \qquad (2)$

$(I-A)^{-1}$ is called the total requirement table or the Leontief inverse.

To derive the impact on employment, we arrive at an employment requirement matrix (E_r) from the Leontief inverse matrix and the employment requirements coefficient matrix (E) where E is a diagonal matrix indicating the employment output ratios (number of people employed/ total output) for each industry. The matrix E_r helps us estimate the number of jobs generated, both directly and indirectly, at any level of planned output.

Therefore, employment generated (E_g) can be estimated as

$$E_g = E_r * Y$$

Since $E_r = E*(I-A)^{-1}$

$$E_g = E* (I-A)^{-1} Y$$

So additional employment generated can be computed as:

$$\Delta E_g = E (I-A)^{-1} \Delta Y \qquad (3)$$

We estimate the employment generated by JJM investments using equation (3). We generated the employment requirements coefficient matrix (E) by computing the employed person/output for each component industry of drinking water supply and is then used to arrive at employment requirement matrix (E_r).

3.2.2. Ratio method

Direct employment

In this method, ratios are developed for empirical analysis and estimates of the ratios are computed using a sample of scheme level data from selected states. Subsequently, the estimated ratios are utilized to extrapolate the results at the state and national level. The ratio we have chosen for this purpose is '*Employment generated to Household'*. We consider household as the unit of estimation as we know the total number to be covered and it is expected to be stable across geographical regions. This method is used for direct employment estimates at both construction and O&M phases.

As a first step, direct labour employment is estimated for each scheme *i* in a state *j* as follows.

$$DLCP_{ij} = TLCP_{ij} / NHH_{ij}$$

Where, $DLCP_{ij}$ is the direct labour requirement per household for sample scheme *i* for state *j* in the construction phase, $TLCP_{ij}$ is total labour requirement in the construction phase in the sample schemes, and NHH_{ij} is number of households to be served in the scheme *i* in state *j*.

As a second step, the average of $DLCP_{ij}$ for the sample states is computed to obtained state average ratio $DLCP_j$. This state ratio was used to compute the potential employment likely to be generated in the state *j* (Egj).

$Egj = DLCP_j * TNHH_j$, where, $TNHH_j$ is the total number of households to be covered under JJM in the state *j*.

In order to compute the potential employment in states other than the sample states, cluster analysis is done. Using cluster analysis, states are clustered based on demographic and hydrological parameters. We compute average cluster ratio from the sampled states in a particular cluster and use it for computing employment in states other than the sample states within the cluster.

The total direct labour requirement per household in the construction phase in other than the sample states *j* (DLCPOj) is thus estimated as:

$DLCPOj = ADLCPc * TNHH_j$

where ADLCPc is the average direct labour requirement per household in the construction phase from the sample states in the cluster *c*.

The same approach is followed in the O&M phase to estimate the employment generation potential utilizing scheme level sample data.

Indirect employment

To assess the indirect employment generation under JJM in the construction phase, we first estimate the budget amount utilized towards materials (B_m) from the total JJM budget (B). For this purpose, we use a sample of public tender documents and the questionnaires filled in by a sample of contractors. The estimate was further disaggregated to specific materials (k) like HDPE pipes, Steel, valves etc., and then multiplied the aggregate budgeted amount for materials (B_m) with the share of individual material (S_k) obtained from the sample, to arrive at the budget amount that will be spent on individual material (BmM_k). That is,

$BmM_k = S_k * B_m$

We computed output generated per employment of each industry (average value of output generated by an employed person) and then arrive at the employment generated due to the additional demand of the input materials used for JJM schemes by multiplying it by $B_m M_k$.

Total indirect labour employment estimated through this method is only partial as it captures only the first stage of indirect employment. The other inputs used in producing materials in the first stage and labour required for producing those materials are not included in this estimate. One can estimate whether there is any effect of scale on labour employment, and if exists, estimates would need to be adjusted accordingly.

We assume that in the case of SVS, employment for tasks such as plumbing, electrical works etc., will be on-demand basis and for a group of SVS the requirement will be approximately the same as the case of an MVS of similar size.

Apart from the above analytical tools, we also incorporate a linear regression model based on the data from representative states to check for potential associations between scheme size/characteristics and employment generation.

3.3 Data and Variables

The IO table for any economy is derived from the observed outputs and the flow of outputs between industries by tracking the monetary flow between a pair of industries. IO tables are useful in understanding the value of input required from different sectors in generating the planned output. We make use of IO table published by Asian Development Bank (Asian Development Bank, 2023) to derive Leontief Inverse matrix. Since Rural Drinking Water Supply (RDWS) is not identified as one of the industries in the current IO table, we create a synthetic industry to study the impact of JJM investments. The output created under piped drinking water is already a part of different identified industries in IO tables and we construct the industry 'RDWS' as an aggregate of already identified industries. For creation of the synthetic industries, we use the data from 11 tenders across 4 states - Karnataka, Odisha, Himachal Pradesh and Kerala. The contracts belong to different stages of the scheme and range from tender values of INR 4 lakhs to 50 Crore. These contracts were obtained from the e-procurement portal (public website) of each of these individual states. Each line item in the tenders was studied and classified under an identified industry. The combined sum of costs of all the contracts is used to calculate the percentage contribution of existing identified industries to the synthetic industry. The breakdown of the share of the synthetic industries are summarised in Table 1.

Table 1. Contribution to Synthetic Industry 'RDWS'

Industry category	Share of Synthetic Industry
Construction	54.14%
Machinery	28.73%
Electrical and optical equipment	7.77%
Basic metals and fabricated metals	6.54%
Rubber and plastics	2.61%
Chemicals and chemical products	0.21%

Source; Authors' calculations
Note: Wood and products of wood and cork also had a negligible share of 0.000024%

The demand vector is generated by multiplying total likely investment in JJM with the share of the component industries (Appendix 1).

The employment output ratios have been derived for the 7 major industries laid out in the national income accounting statistics. Since the industry wise allocation of GDP was not available, we used the percentage allocation of GVA for the year 2022-23 and applied it to the GDP data. We believe that this is the closest estimate possible since the GDP of a country is net taxes added to GVA. The total worker population for the country stood at 50,82,65,520 at the end of 2022. This was derived by multiplying the worker population ratio (WPR) for the year 2021-22 with the total population (> age 15) estimated by the world bank for 2022. The WPR is calculated based on the PLF Survey carried out by National Sample Survey Organisation every year.

The worker population is further allocated to the 8 major industries as per the allocation of GDP and the GDP per worker is computed (Appendix 2). We then mapped these eight employment output ratios to 35 industries in the IO table based on their correspondence as indicated in Appendix 3.

For estimating the direct employment generation under JJM schemes, we consider total employment generated and total number of households covered at the scheme level. Utilizing these two variables the employment-to-household ratio normalized to 100 households is generated. A detailed list of variables with definitions and measurements is presented in Appendix 4.

3.3.1. Sampling and summary statistics

We utilize secondary as well as primary data in this study. For primary data collection we selected one highest score (best performing) district in each region in all major states as given in Jal Jeevan Sarvekshan report of December 2022. We listed all the completed schemes in the selected district and requested the JJM mission directors of the states to provide scheme level information. A well-defined data format with a list of sample districts and a list of completed schemes (n=854) was shared with respective states. Details of sample districts and number of schemes are given in Appendix 5. The data format includes questions related to the scheme characteristics and employment type such as nature of the scheme (new/retrofitting), category of the scheme (SVS/MVS), phase of its implementation (construction/O&M), number of villages the scheme covers, number of population and households covered, estimated cost of the scheme, total water supply capacity of the scheme, service level capacity of the scheme (lpcd), and a set of questions related to employment for various positions (refer to Appendix 4). We also reached out to eight contractors from Tamil Nadu and four contractors from Karnataka and interviewed them using the same sets of questions and data format to understand certain benchmarks for the scheme level data. Since the program is currently under implementation, the total number of completed schemes was dynamic in nature. Due to this, there was more scheme data (1067) that we received than originally planned. These data were from Andhra Pradesh, Assam, Goa, Gujarat, Karnataka, Kerala, Punjab, Uttar Pradesh, Uttarakhand, Tamil Nadu, Maharashtra and Jharkhand states. However, after screening the data, we dropped Goa and Assam state schemes from our analysis as the data from these states were outliers.

Table 2 and 3 show the summary statistics of scheme level data and their characteristics. A total of 1067 schemes data was collected among which 81 schemes belonging to Assam and Goa, and 69 schemes from other states, were dropped after screening for outliers and population coverage of at least 20 households and 100 people. As a final consideration, we included 917 schemes, out of which 58.01% are SVSs, 41.98% are MVSs, and 72.08% are from construction phase and 27.91% are from O&M phase. Further, among the schemes from construction phases, 76.18% were of retrofitting and 23.81% were new schemes.

The scheme coverage statistics show that on average, the total manpower employed under a MVS is 26 and SVS is around 4, total village covered for MVS and SVS is 9 and 1 with average population of 15874 and 1093 people and 2677 and 278 households respectively. The average water supply capacity per MVS and SVS is 1.85 and 0.49 mld (million litres per day) with an average per capita cost of 8445 and 7549 Indian rupees, respectively. The low per capita cost of some schemes mostly belonged to retrofitted schemes (Appendix 6). There are variations in costs across states. In states such as Uttarakhand, Jharkhand, and Uttar Pradesh the costs are high likely due to the nature of geographical and demographic differences and new constructions (Appendix 7).

Table 2. Summary Statistics of Sampled Schemes under JJM

Parameter (n=917)	**MVS** (n=385)			**SVS** (n=532)		
	Mean (SD)	Min	Max	Mean (SD)	Min	Max
Total manpower	25.97 (81.57)	0.1	1155	3.70 (6.25)	0.08	83.5
Number of villages	9.32 (20.82)	1	212	1.01 (0.18)	1	5
Population coverage	15874.46 (61247.9)	112	894119	1093.68 (1668.68)	106	27807
Household coverage	2676.94 (8524.73)	30	99486	278.49 (492.60)	20	6160
Water supply capacity (MLD)	1.85 (3.76)	0.01	34.82	0.49 (1.33)	0.004	9.2
Estimated cost per capita (INR)	8445.68 (10542.92)	67.48	81801.7	7549.21 (8956.36)	19.44	58284.88

MLD: Million Liter Per Day
Note: 56 MVSs from Punjab, Kerala, Uttarakhand and Gujarat were reported covering single village.

Table 3. Characteristics of Sampled Schemes under JJM

Scheme characteristics	**% of schemes** (N=917)
Types of schemes	
Multi Village Schemes (MVS)	41.98
Single Village Schemes (SVS)	58.01
Nature of schemes	
Retrofitting	76.18
New	23.81
Phases of implementation	
Construction	72.08
Operation & Maintenance (O&M)	27.91

Note: proportions for nature of schemes are calculated from a small sample scheme (n=550) due to unavailability of data

3.3.2 Clustering of states

In order to use appropriate ratio for the states from where we did not receive scheme level data, we employed clustering method to group the states. The idea is that within a cluster, if any state lacks scheme level data, then the average estimates from the cluster (average of states with scheme level data) can be utilized. As a first step towards estimating the direct employment potential, we group the states into three clusters using certain state level parameters such as population density, river length per 1000 population, water body area per 1000 population, groundwater availability per 1000 population, and worker population ratio of casual labour per 1000 population. These variables are expected to have an impact on the employment generated in any drinking water supply system.

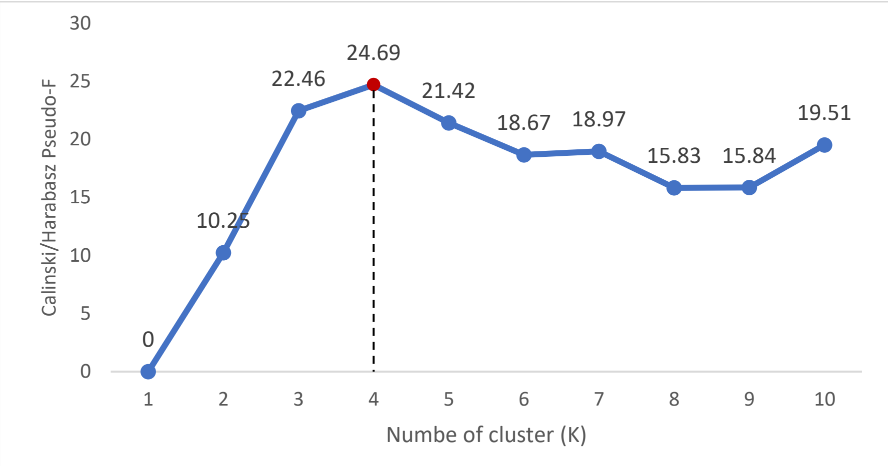
To generate the clusters based on the above parameters we use 'K-means' clustering method. While generating the clusters, choosing the optimal number of clusters of (k) is essential which can be decided based on the prior knowledge of the data; however, often we lack prior information when we have multiple parameters to decide the 'k'. In this case, the potential grouping is either decided using a general rule of thumb i.e., $k = \sqrt{n}/2$, where n is the number of observations (states in our case), or by using statistical measures such as: elbow method, silhouette coefficient, gap statistics and dendrograms in hierarchical clustering. In our study we employed Calinski-Harabsaz (CH) Pseudo-F statistics to plot the elbow chart. The CH Pseudo-F assesses the sum of squared distance within the cluster and compares it to the un-clustered data, taking into account the number of clusters (Halpin, 2016). The CH index for each cluster solution is calculated by regressing each variable on the cluster solution and cumulating the model sum of squares (MSS) and residual sum of squares (RSS) to generate the pseudo-F statistic as follows:

$$p^F = \frac{\sum MSS/(g-1)}{\sum RSS/(N-g)}$$

Where N is the number of cases and g the number of groups.

The values of CH pseudo-F are then plotted against the number of clusters (k) to identify the kink/elbow point on the curve which denotes the optimal number of clusters (k), which is 04 in our case (Figure 2).

Figure 2. Elbow Plot for Optimal Number of Clusters (k).



Note: Calinski-Harabsaz (CH) Pseudo-F measures within and between cluster sum of square taking into account different number of clusters

Utilizing the above formula, we created three clusters of the Indian states which include: Uttar Pradesh, Kerala, West Bengal, Tamil Nadu and Bihar as the first cluster; Punjab, Gujarat, Maharashtra, Karnataka, Andhra Pradesh, Rajasthan, Chhattisgarh, Madhya Pradesh, Haryana, Tripura, Odisha and Jharkhand as the second cluster; and Uttarakhand, Goa, Assam, Himachal Pradesh, Jammu and Kashmir, Mizoram, Nagaland, Meghalaya, Manipur, and Arunachal Pradesh as the third cluster. It may be noted that the K-means method created Arunachal Pradesh as a separate cluster because of its low population density; however, considering similarities in characteristics of north-eastern states, we included Arunachal Pradesh in the third cluster along with other major north-eastern states. Furthermore, due to unavailability of data on few parameters, we do not include Union Territories (UTs) in our cluster analysis; however, we create a separate group for Union territories for which employment is estimated using national average ratio.

4. Results

4.1. Employment generation under construction phase of JJM schemes

The IO model estimates the direct and indirect employment potential across both MVS and SVS schemes. We use equation 3 to estimate the impact of JJM investments on the final employment generation potential. The estimated employment generated at the construction phase obtained from IO model is 2,82,48,478 person-year for the total investment under JJM (Appendix 3).

The construction industry has the highest employment potential at 1,39,42,573 person-year followed by the machinery and basic metals industry. This is due to the nature of the water treatment plants and distribution networks which require heavy investments in constructing large tanks, large amounts of iron and steel pipes, etc. The construction industry has 49% contribution to employment generated but only a 35% contribution to the increased output, since the employment intensity of the industry is higher than overall average.

Whenever investments in large infrastructure projects are made, there is a multiplier effect on the economy. In the construction stage, the employment used while constructing the infrastructure is considered a direct employment under JJM and the employment generated to produce the materials used in the construction is the first stage indirect employment and the employment generated in producing raw materials for the first stage is the second stage indirect employment, and so on. Using the IO model, we get the aggregate employment potential across multiple stages. To break this down into the direct employment potential and the first stage indirect employment, we use the ratio method.

4.1.1. Direct employment potentials in construction phase of JJM

The direct employment generated under the construction of schemes at state and national level are provided in Table 4. All the Indian states were clustered into three groups based on certain parameters. Subsequently, the direct employment potential is extrapolated using the cluster/national average of employment-household ratios of the reference states in respective clusters. Overall, with the aim of providing potable piped water supply to each household in rural India, JJM has a potential to generate 59,93,154 person-year of direct employment in the construction stage of the water supply schemes (Table 4). The highest ratio of employment generated in the construction phase was in Maharashtra (6.31 per 100 HH) followed by Tamil Nadu (4.40 per 100 HH). Whereas the ratios of employment generated for Andhra Pradesh (0.4 per 100 HH) and Gujarat (0.6 per 100 HH) are lowest. This variation is mainly due to the differences in the type and nature of the schemes. For instance, majority of schemes from Tamil Nadu were the construction of MVS, whereas, in Andhra Pradesh majority of schemes were construction of SVSs and in Gujarat although majority of schemes are MVS, they are of retrofitting in nature.

4.1.2. Indirect employment potential in construction phase JJM

The Jal Jeevan Mission has resulted in additional demand for the outputs in multiple industries like cement, iron pipes, sand, pumps, and valves etc. The employment generated during this first stage of indirect employment due to the additional demand of these materials has a substantial impact on the indirect employment numbers generated by JJM.

To calculate the indirect employment generated by JJM in this first stage, we have attempted to estimate the breakup between spending on materials and labour. This has been done by interviewing 5 contractors in Karnataka as well as reviewing 11 tender documents from 4 different states (Kerala, Karnataka, Odisha and Himachal Pradesh). The average proportion of cost of materials across all the sources is 72%, which is indicative of the total tender budget used on physical materials, the breakdown of which is summarized in Appendix 8. Considering the output from these industries is generated at average productivity of employed person in India (Appendix 3), the indirect employment generated in the first stage stands at 77,34,620 person-year during the construction stage of the mission. The employment generated in specific industries is summarized in Table 5. The remaining 1,45,20,704 person-year employment, out of the total indirect employment of 2,22,55,324 person-year, is generated in the production of inputs used in manufacturing of materials required in the first stage.

Table 4. Estimated Direct Employment per 100 Households in Construction Phase of Implementation in Different States.

Clusters (Representative States)	States	No. of rural Households	Employment in construction phase (per 100 household)	Total direct employment-construction phase
C1 (Tamil Nadu, Uttar Pradesh, Kerala)	**Tamil Nadu**	12,50806	4.40	552235
	Uttar Pradesh	26619580	4.01	1067445
	Kerala	7068719	1.77	125116
	West Bengal	18393602	3.42	629061
	Bihar	16629997		568746
C2 (Punjab, Gujarat, Maharashtra, Karnataka, Andhra Pradesh, Jharkhand)	**Punjab**	3425723	1.97	67487
	Gujarat	9118449	0.60	54711
	Maharashtra	14673332	6.31	925887
	Karnataka	10117551	2.61	264068
	Andhra Pradesh	9517861	0.40	38071
	Jharkhand	6120293	4.13	252768
	Telangana	5398219	2.39	129017
	Rajasthan	10530458		251678
	Chhattisgarh	5009375		119724
	Madhya Pradesh	11979642		286313
	Haryana	3041314		72687
	Tripura	741945		17732
	Odisha	8863154		211829
C3 (Uttarakhand)	**Uttarakhand**	1494265	2.52	37655
	Assam	6802443	2.52	171422
	Goa	263013		6628
	Himachal Pradesh	1708705		43059
	Jammu and Kashmir	1909457		47078
	Mizoram	133329		3360
	Nagaland	366001		9223
	Meghalaya	635032		16003
	Manipur	451566		11379
	Arunachal Pradesh	230275		5803
Union Territories	**Andaman and Nicobar Islands**	62037	2.53	1569
	Dadra and Nagar Haveli and Daman & Diu	85156		2154
	Chandigarh	N/A		N/A
	Delhi	N/A		N/A
	Lakshadweep	13,370		338
	Puducherry	114969		2908
Total				**59,93,154**

Note: i) Total direct employment is the product of 'Total Employment per household' and 'No. of rural Households' ii) total direct employment for the above states are estimated using the average employment-household ratio of the reference states in the respective clusters, iii) clustering of states was done taking into account population density, river length, water body area, ground water availability and worker population ratio of casual labour, iv) Jammu and Kashmir is considered as a state which includes rural household of UT Ladakh v) estimated for UT Chandigarh and Delhi could not be presented due to unavailability of data.

4.2. Employment generation under O&M phase of JJM

This section presents the estimates of employment generation in the O&M phase of the schemes as shown in Table 6. As of 2019, there were 3,23,62,838 rural households with FHTC; further a total of 16,22,17,522 households were planned to be covered under JJM. At national level, JJM is potentially generating 13,25,919 person-year of employment in the O&M phases;

out of which 11,18,749 person-year of employment can be ascribed to the JJM period (post 2019). The highest employment in the O&M phase was recorded in Maharashtra (0.89 per 100 HH) while the lowest was in Gujarat (0.36 per 100 HH).

Table 5. Employment Generated in Industries Supplying Raw Materials to JJM

Product manufactured	Additional employment generated
Cement	13,54,066
Steel/GI Pipes	6,21,246
Pumps/ Sluice Valves	11,05,943
HDPE Pipes	13,52,796
Diesel	73,035
Ductile/ Cast iron pipes	21,21,591
Valves	11,05,943
TOTAL	77,34,620

4.3. Skilled and unskilled employment generation under JJM

To estimate the total manpower of a scheme, we aggregated various positions such as Team Leader, Plant in-charge, Supervisor, Scada in-charge, Scada operator, Electrician, Valve man, Pump operator, Chemist, Lab technician, Plumber, Helper/Watchman and labourer (refer to Appendix 4). To estimate different types of employment, we created two categories i) Skilled labour employment and ii) Unskilled labour employment, estimated as a part of direct employment using the ratio method. The unskilled labour employment includes Helpers/Watchmen and labourers, while the skilled labour employment takes into account the remaining positions. In some cases, data did not reveal the type of employment. We included them under unskilled employment.

Our result suggests that JJM has the potential to generate 24,27,553 person-year of skilled labour employment (40.5%) and the remaining 35,65,601 person-year of unskilled labour employment at the national level, in its construction phase. Meanwhile, in the O&M phase, JJM has the capacity to generate a total number of 7,29,156 person-year of skilled (65%) and 3,89,593 person-year of unskilled labour employment annually. Estimates of skilled and unskilled labour employment at each state level are presented in Appendix 9 and 10.

Impact on GDP

Equation 2 also helps in estimating the impact JJM investment on GDP. The additional GDP generated by the total planned investment by JJM turns out to be INR 1.74 for every rupee of investment. With this ratio, the additional GDP generated can be computed annually utilizing the data on the investment made in that year.

5. Summary and Conclusion

To summarize, we started with IO model to estimate the overall employment generation potential under JJM in its construction phase which was estimated to be 2,82,48,478 persons for the total investment of JJM. Since the construction phase has multiple levels of employment generation such as construction of infrastructure (direct employment) and production of raw materials required for the construction in the first stage and subsequent stages (indirect employment), it was important to draw a distinction between them. To differentiate between the two levels of employment, we used scheme level employment-household ratio normalized per 100 household for the sample states and cluster average ratio for the other states. The estimated direct employment likely to be generated in the construction phase is 59,93,154 person-year. Subsequently, using a deductive approach, we show that out of the remaining 2,22,55,324 person-year of employment 77,34,620 person-year is associated with the manufacturing of direct materials utilized in the construction of JJM schemes. The remaining 1,45,20,704 person-year employment is generated in the subsequent stages.

Unlike the construction phase, in which employment is temporary or created for a stipulated period, the O&M phase generates employment which is perpetual in nature. During the O&M stage, the total potential employment generation is estimated to be 13,25,918 person-year. However, this figure cannot be attributed to the JJM completely because of previously existing drinking water supply schemes and manpower affiliated to them. To address this issue, we segregated the FHTC coverage into 'pre-JJM period' (till 2019) and 'JJM period' (2019 onwards). As of August 2019, 16.63% of rural households were provided with FHTC and 16,22,17,522 FHTCs i.e., 83.37% of rural households are targeted to be covered by JJM. This distinction has led to an estimation of 11,84,899 person-year of employment in the O&M phase under the JJM period. A detailed outline of employment potentials at different levels of

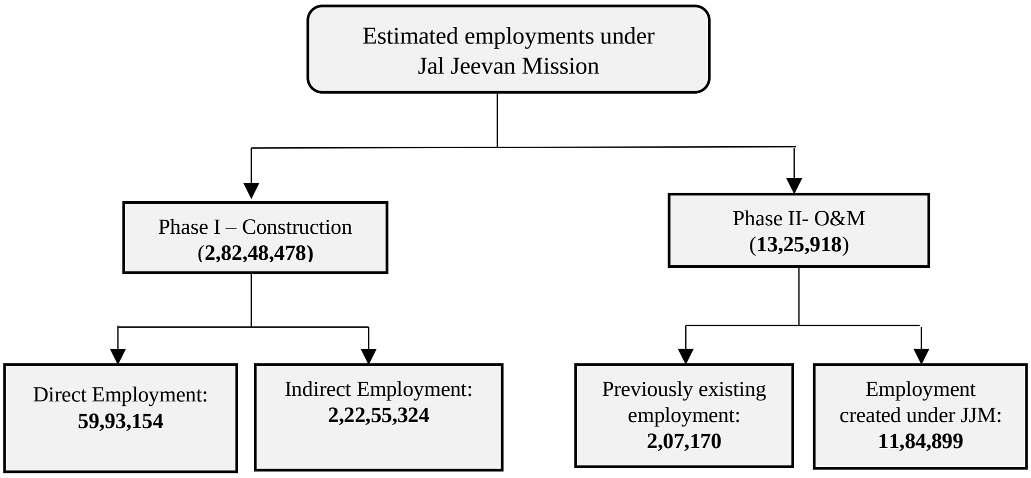
Table 6. Estimated Direct Employment per 100 Households in O&M Phase of Implementation in Different States.

Clusters (Ref State)	**States**	**No. of rural Households**	**No. of rural household to be covered in JJM period (2019-2024)**	**Employment in O&M phase (per 100 household)**	**Total direct employment- O&M phase**	**Total Direct employment post-JJM period- O&M phase**
C1 (Tamil Nadu)	**Tamil Nadu**	1,25,50,806	1,03,76,744	0.65	81580	67449
	Uttar Pradesh	2,66,19,580	2,61,10,597		173027	169719
	Kerala	70,68,719	54,15,333	0.65	45947	35200
	West Bengal	18393602	1,82,11,856		119558	118377
	Bihar	16629997	1,63,13,988		108095	106041
C2 (Punjab, Gujarat, Maharashtra, Karnataka, Andhra Pradesh)	**Punjab**	34,25,723	17,47,165	0.79	27063	13803
	Gujarat	91,18,449	26,02,191	0.36	32826	9368
	Maharashtra	1,46,73,332	98,29,500	0.89	130593	87483
	Karnataka	1,01,17,551	76,65,436	0.64	64752	49059
	Andhra Pradesh	95,17,861	64,80,530	0.56	53300	36291
	Jharkhand	61,20,293	57,75,128		45290	42736
	Telangana	53,98,219	38,29,918		39947	28341
	Rajasthan	10530458	96,27,674		77925	71245
	Chhattisgarh	5009375	46,90,159		37069	34707
	Madhya Pradesh	11979642	1,06,13,577	0.74	88649	78540
	Haryana	3041314	12,74,951		22506	9435
	Tripura	741945	7,18,136		5490	5314
	Odisha	8863154	85,55,884		65587	63314
C3 (Uttarakhand)	**Uttarakhand**	14,94,265	13,63,953		11207	10230
	Assam	68,02,443	66,91,132		51018	50183
	Goa	2,63,013	63,919		1973	479
	Himachal Pradesh	1708705	9,46,002		12815	7095
	Jammu and Kashmir	1868193	1332577	0.75	14011	9994
	Mizoram	133329	1,23,859		1000	929
	Nagaland	366001	3,55,413		2745	2666
	Meghalaya	635032	6,47,016		4763	4853
	Manipur	451566	4,25,646		3387	3192
	Arunachal Pradesh	230275	2,07,479		1727	1556
	Andaman and Nicobar Islands	62,037	33,490		465	251
	Dadra and Nagar Haveli and Daman & Diu	85,156	85,156	0.75	639	639
	Chandigarh	N/A	N/A		N/A	N/A
	Delhi	N/A	N/A		N/A	N/A
	Lakshadweep	13,370	13,370		100	100
	Puducherry	1,14,969	21,463		862	161
Total					**13,25,919**	**11,18,749**

Note: i) Total direct employment is the product of 'Total Employment per household' and 'No. of rural Households' ii) total direct employment for the above states are estimated using the average employment-household ratio of the reference states in the respective clusters, iii) clustering of states was done taking into account population density, river length, water body area, ground water availability and worker population ratio of casual labour, iv) Jammu and Kashmir is considered as a state which includes rural household of Ladakh UT, v) estimates for UT Chandigarh and Delhi could not be presented due to unavailability of data.

implementation of JJM is presented in Figure 3. Further, our findings from the regression analysis show a significant size effect i.e., with an increase in the size of population under a scheme, employment generation per 100 households reduces. Besides, the findings also show that the employment per 100 households in the construction phase is significantly higher than employment in O&M phase (Appendix 11).

Figure 3. Average Annual Employment Generation Potential in Different Stages of Implementation of JJM.



Source: Authors' estimation

Note: The indirect employment of 2,22,55,324 represents the overall indirect employment, out of which 77,34,620 is the 1st stage employment and the remainder (1,45,20,704) can be considered as employment in subsequent stages

This study is an attempt to estimate the total potential employment likely to be generated due to the implementation of Jal Jeevan Mission. The employment is generated during two stages of drinking water supply schemes: construction and operation and maintenance. We estimate the potential employment generated during these two stages separately. For the construction stage, we use input-output analysis method which takes care of both direct and indirect employment generated in related industries. Further, we estimated the direct employment and part of indirect employment through the ratio method. We estimate only the potential direct employment generated during operations and maintenance stage as indirect employment generated is likely to be small. Assuming the sample we have used is representative and free from bias, these estimates help us to understand the extent of employment likely to be generated due to JJM and indicates that the impact of JJM is likely to be substantial once it is properly completed and made operational.

5.1. Limitations of the study

a) The mission is still in its implementation phase, and the total number of schemes at any point of time was dynamic, hence, it was difficult for us to draw a sample of schemes with minimum frame error. Although we collected scheme (completed) level data for a sample of districts, due to various factors and unavailability of data we do not claim our sample (selected schemes) to be an accurate representation of the population (total schemes under JJM). Moreover, this is one of the impeding factors which constrained us from estimating employment separately for different scheme types (MVS/SVS) and nature (new/retrofitting) of the schemes.

b) Our study does not capture the induced employment effect in the indirect employment creation due to unavailability of data. Further, due to data constraint indirect employment estimation was considered only for construction phases. However, this is unlikely to be a large number in O&M phase.

c) Although we estimated employment for different categories such as skilled and unskilled employment, the availability of data did not permit us to assess the quality of work and identify the beneficiaries of the employment creation.

d) Regression results show there is size effect. The employment potential for 100 households decreases with the increase in the size (population) of the scheme. However, we could not make use of this as the data on the size of all schemes that are likely to be taken up is not available.

e) There are some limitations of IO model approach pointed out in the literature such as IO analysis assumes that the monetary value of demand for the output of any industry is determined by considerations that are unrelated to the amount being produced in the sector (Blair & Miller, 2022) and this assumption does not mirror the reality in any economy where the money value of the output would be related to the demand-supply situation in the sector and is a shortcoming of this analysis. Another assumption in IO analysis is fixed technical coefficients and fixed proportions which implies technology remains constant even as output grows (Garrett-Peltier, 2017). Fixed technical coefficients imply that the amount of input required of sector i per unit of output in sector j remains constant. The possibility of increasing or decreasing returns to scale are not accommodated in the model. Fixed proportions imply that the proportion of inputs from different sectors to produce the output in a sector remains constant even as a large increase in demand is introduced (Blair & Miller, 2022). Another concern expressed is different sectors have a different employment intensity and will vary over time. The assumption of a fixed employment intensity for the economy will underestimate the employment generation since the employment elasticity of industry and service sectors is higher than the economy average in both South Asian and lower middle income economies, groups of which India is a part in the IMF study (Furceri, Crivelli, & Toujas-Bernate, 2012).

Acknowledgement:

We acknowledge the valuable suggestions received from the ILO team led by Tomas Stenstrom. We thank the state governments and the respective mission directors of Andhra Pradesh, Gujarat, Karnataka, Kerala, Punjab, Uttar Pradesh, Maharashtra, Tamil Nadu Uttarakhand and Jharkhand for furnishing required data that helped us conduct this study.

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Appendices

Appendix 1: Demand Vector Generated for the JJM Investment

Industry	**Demand Vector (in Rs)**
Agriculture, hunting, forestry, and fishing	-
Mining and quarrying	-
Food, beverages, and tobacco	-
Textiles and textile products	-
Leather, leather products, and footwear	-
Wood and products of wood and cork	19,11,63,729
Pulp, paper, paper products, printing, and publishing	-
Coke, refined petroleum, and nuclear fuel	-
Chemicals and chemical products	16,31,07,94,297
Rubber and plastics	2,03,87,82,91,741
Other non-metallic minerals	-
Basic metals and fabricated metal	5,09,90,56,64,600
Machinery, nec	22,40,67,53,74,265
Electrical and optical equipment	6,06,34,65,84,814
Transport equipment	-
Manufacturing, nec; recycling	-
Electricity, gas, and water supply	-
Construction	42,22,69,21,26,555
Sale, maintenance, and repair of motor vehicles and motorcycles; retail sale of fuel	-
Wholesale trade and commission trade, except of motor vehicles and motorcycles	-
Retail trade, except of motor vehicles and motorcycles; repair of household goods	-
Hotels and restaurants	-
Inland transport	-
Water transport	-
Air transport	-
Other supporting and auxiliary transport activities; activities of travel agencies	-
Post and telecommunications	-
Financial intermediation	-
Real estate activities	-
Renting of M&Eq and other business activities	-
Public administration and defense; compulsory social security	-
Education	-
Health and social work	-
Other community, social, and personal services	-
Private households with employed persons	-
Total	**78,00,00,00,00,000**

Note: The total is obtained by the product of average cost of household connection and total household to be covered.

Appendix 2: GDP Per Person Employed and Output Per Worker in Different Industries

Particulars	**Value**
Total GDP in the year 2022-23 (at current prices, Crore INR)	273,07,751
Worker Population Ratio (PLFS 21-22)	52.90%
Total population (15- 64 years of age) in 2022	96,08,04,385
Worker population in 2022	50,82,65,520
GDP per employed person in the year 2022-23	5,37,273

Industry	**GVA (in cr)**	**Contribution to GVA**	**GDP per sector (in Cr)**	**WPR (per 100)**	**Worker population**	**Output per worker**
Total	2,57,56,470	100%	2,73,07,751	100	50,82,65,520	5,37,273
Agriculture, forestry and fishing	39,80,067	15%	42,19,782	48.9	24,84,92,141	1,69,815
Mining and quarrying	5,13,076	2%	5,43,978	0.54	27,44,085	19,82,366
Manufacturing	33,07,315	13%	35,06,511	12.6	6,40,28,650	5,47,647
Electricity, gas, water supply and other utility services	5,86,679	2%	6,22,014	0.52	26,42,452	23,53,927
Construction	17,19,098	7%	18,22,637	10.6	5,38,65,372	3,38,369
Trade, repair, hotels and restaurants	35,28,896	14%	37,41,437	10.96	5,56,94,762	6,71,775
Transport, storage, communication & services related to broadcasting	45,43,303	18%	48,16,941	4.83	3,29,79,836	14,60,571
Financial services		0%		1.66		
Real estate, ownership of dwelling and professional services	31,70,966	12%	33,61,949	0	4,78,18,222	7,03,069
Public administration and defence		0%		9.41		
Other services (industry)	44,07,070	17%	46,72,502	0	-	5,37,273

Data sources: Economic Survey 2023-23 and EPW Research Foundation and the World Bank

Appendix 3: Industry wise Potential Employment Generated

Industry	**National Income Accounting Industry**	**Employment generated**
Agriculture, hunting, forestry, and fishing	Agriculture, forestry and fishing	10,00,280
Mining and quarrying	Mining and quarrying	57,637
Food, beverages, and tobacco	Agriculture, forestry and fishing	1,23,815
Textiles and textile products	Manufacturing	18,143
Leather, leather products, and footwear	Manufacturing	-
Wood and products of wood and cork	Agriculture, forestry and fishing	2,85,743
Pulp, paper, paper products, printing, and publishing	Agriculture, forestry and fishing	84,284
Coke, refined petroleum, and nuclear fuel	Mining and quarrying	1,10,106
Chemicals and chemical products	Industry	4,22,559
Rubber and plastics	Manufacturing	5,35,795
Other non-metallic minerals	Mining and quarrying	2,34,380
Basic metals and fabricated metals	Manufacturing	31,35,772
Machinery, nec	Manufacturing	44,87,314
Electrical and optical equipment	Industry	13,97,300
Transport equipment	Transport, storage, communication & services related to broadcasting	49,269
Manufacturing, nec; recycling	Manufacturing	2,523
Electricity, gas, and water supply	Electricity, gas, water supply and other utility services	1,47,369
Construction	Construction	1,39,42,573
Sale, maintenance, and repair of motor vehicles and motorcycles; retail sale of fuel	Trade, repair, hotels and restaurants	730
Wholesale trade and commission trade, except of motor vehicles and motorcycles	Trade, repair, hotels and restaurants	3,05,147
Retail trade, except of motor vehicles and motorcycles; repair of household goods	Trade, repair, hotels and restaurants	5,85,608
Hotels and restaurants	Trade, repair, hotels and restaurants	34,059
Inland transport	Transport, storage, communication & services related to broadcasting	1,45,109
Water transport	Transport, storage, communication & services related to broadcasting	-
Air transport	Transport, storage, communication & services related to broadcasting	-
Other supporting and auxiliary transport activities; activities of travel agencies	Transport, storage, communication & services related to broadcasting	12,403
Post and telecommunications	Transport, storage, communication & services related to broadcasting	68,250
Financial intermediation	Financial services	2,82,246
Real estate activities	Real estate, ownership of dwelling and professional services	7,222
Renting of M&Eq and other business activities	Real estate, ownership of dwelling and professional services	7,14,929
Public administration and defense; compulsory social security	Public administration and defence	-
Education	Public administration and defence	11,727
Health and social work	Public administration and defence	7,149
Other community, social, and personal services	Public administration and defence	39,038
Private households with employed persons	Industry	-
Total		**2,82,48,478**

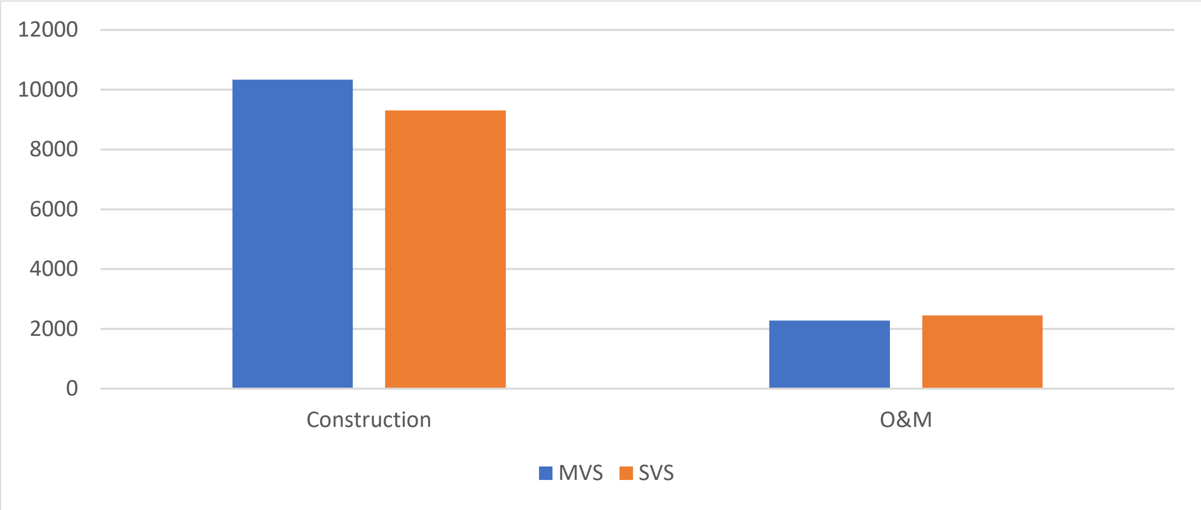
Appendix 4. List of Variables and Definition.

Indicators	**Variable**	***Eligibility/Definition/Measure***
Total employment	Tot_Emp	Total number of people employed in various positions for the O&M of MVS
Total employment per 100 households	Tot_Emp_100HH	Estimated employment at household level (Total employment/number of households * 100)
Team leader	Team_lead	An Engineer OR Community Development Specialist (CDS)
Plant in-charge	Plant_in_charge	Civil/Environmental/Mechanical/Electrical engineer with working experience in O&M activities, particularly of water supply schemes
Supervisor	Supervisor	Civil/Mechanical Engineer with demonstrated Project Management skills
Scada in charge	Scada_in_charge	Electrical & Electronic Engineer with 5 years of working experience in the field of SCADA operation and monitoring
Scada operator	Scada_op	Electrical & Electronic Engineer with 3 years of working experience in the field of SCADA operation and monitoring
Electrician/Mechanic	Elect_Mech	Experience in repairs and maintenance of electro-mechanical items of water supply components and minimum 3-year experience in this field
Valve men/Fitters	ValveM_Fitter	He should observe regularly the pipelines / valves for any leakages and if any leakages are found. Should also maintain logbooks of village OHT.
Pump operators	Pump_op	Having experience in repairs and maintains of different types of pumps, he should look after pumping machinery to keep record of logbook of pumping machineries, water- meter reading etc as directed
Helpers/Watchmen	Helper_WatchM	He should assist pump operators in repair works. And also work as a watchman and look after maintenance.
Chemist	Chemist	A Postgraduate/ Graduate in Science and should have experience of minimum 3-year experience in this field
Lab technician	Lab_tech	Bachelor’s Degree in science and should have experience of minimum 2-year experience in this field
Plumber	Plumber	Installing and maintaining pipe and tap connections.
Others	Other	Manpower employed anonymously on requirement for which position is not defined.
Demographic & Economic indicators		
Estimated Total Population	Est_pop	Ratio of *Total water supply capacity (mld)* and *Rate of water supply (lpcd)*
Estimated Total household	Est_HH	Estimated by dividing *Estimated Total Population* by 5 (5 is a hypothetical number represents 5 members from a household on an average)
No. of Villages	Tot_village	Total number of villages covered under the work
Total Water supply capacity	Tot_Wsupply_cap	Litres of water supply capacity at Water Treatment Plant (WTP) outlet per day (measured in million litres per day (MLD))
Rate of water supply	Rate_Wsupply	Number of liters of water supplied per capita per day (measured in litres per capita per day (LPCD))
Estimated cost of work	Est_cost	Estimated cost of O&M of a MVS

Appendix 5: List of District and Sample Schemes Selected for Data Collection

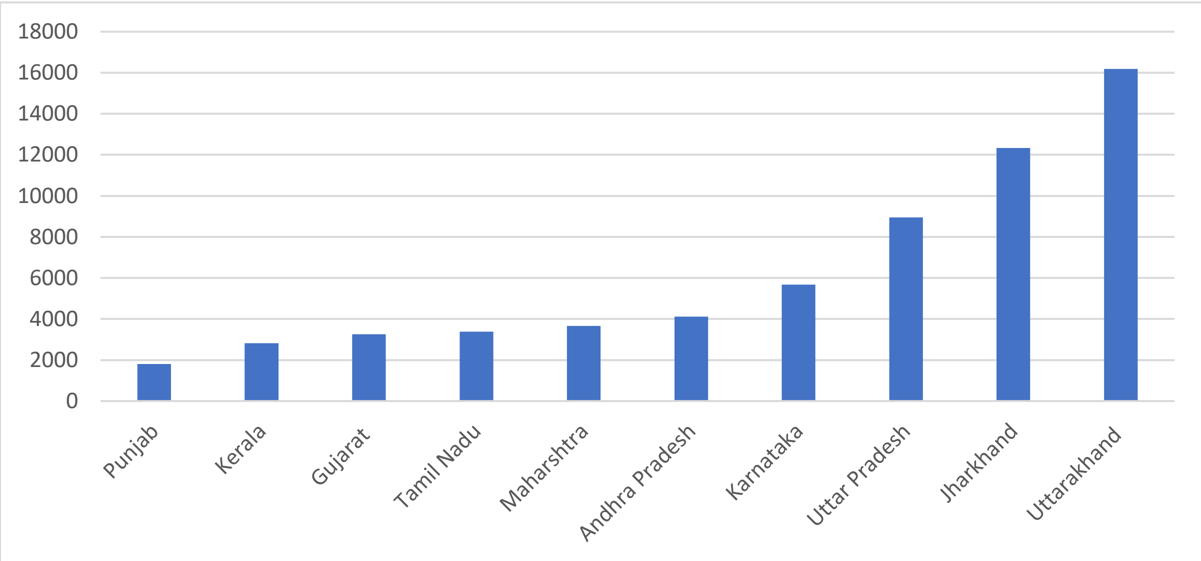
State	**District**	**Sample schemes selected (n=854)**	**Sample schemes collected (n=1067)**
Andhra Pradesh	YSR (08), Alluri Sitharama Raju (35), Guntur (21)	64	122
Assam	Golaghat (31), Udalguri (185), Salmara-Mankachar (02), Nagaon (03), Hailakandi (04)	225	16
Goa	North Goa (17), South Goa (25)	42	65
Gujarat	Kutch (07), Porbandar (01), Dang (03), Patan (02), Chhotaudepur (03)	16	12
Karnataka	Ramanagara (174), Belagavi (06), Yadgir (17)	197	72
Kerala	Kerala (16)	16	16
Punjab	Tarn Taran (27), Malerkotla (50), Kapurthala (30), Rupnagar (32)	139	308
Uttar Pradesh	Mainpuri (01), Fatehpur (03), Shahjahanpur (01), Lucknow (01), Shamli (05), Varanasi (01)	12	20
Uttarakhand	Garhwal (02), Champawat (04)	06	339
Tamil Nadu	Tirunelveli (05), Erode (10)	15	15
Maharashtra	Nagpur (25), Amaravati (03), Jalna (07), Jalagaon (44), Satara (34), Sindhudurg (08)	121	66
Jharkhand	Simdega (01)	01	16

Appendix 6. Average Cost Per Capita by Scheme Characteristics



Source: Authors' contribution from sample data

Appendix 7. Average of Cost Per Capita by States



Source: Authors' contribution from sample data

Appendix 8. Breakdown of Budget Between Different Raw Material Industry (Share)

Source		HDPE Pipes	Iron Pipes	Mild Steel Pipes	Cement	Reinforcement Steel	Sand/Aggregates	Valves	Diesel	Labour and other activity	Share of Material Cost
Contractor	Suprada Materials	7%	25%	6%	1%	2%	1%	2%	5%	Not mentioned	49%
Contractor	Amar Infra	14%	11%		2%	4%	3%	4%			38%
Contractor	Sudheer Naidu	39%	7%		1%	2%		2%			51%
Tender Document	Providing FHTCs to 3550 Households in SAVALAGI habitation of SAVALAGI village, Jamkhandi talauka through SVS to SAVALAGI village in Bagalkote district .	16%	4%	0%	34%	4%	9%	15%	0%	18%	82%
Tender Document	Providing FHTC's to 512 House holds in Hebballi Habitation of Hebballi Village in Badami Taluka of Bagalkot District (SVS)(512FHTC+270Retro=782 Nos)(Gen)	25%	31%	0%	16%	0%	7%	2%	0%	18%	82%
Tender Document	Providing FHTCs to 208 Households in Hosahalli habitation of Hosahalli village in Arkere G.P of Tumkur taluk in Tumkur district by Agumentation & Retrofiting through SVS	17%	29%	2%	14%	0%	21%	3%	0%	14%	86%
Tender Document	Supplying and laying distribution line and providing FHTC in Vanchikappara area- Pipe line work Contract	0%	72%	0%	13%	2%	3%	5%	0%	5%	95%
Tender Document	Retrofitting and source level augmentation of varous leftout habitations by providing FHTC under JJM 3rd phase under 4SV Sub-Division Swarghat Tehsil Sh. Naina Devi Ji District Bilaspur (SW: Energisation of Mini Tube well).(SH: Supply and Erectionof Submersible pumping machinery with allied accessories at village Behal)	0%	8%	1%	0%	0%	4%	52%	0%	34%	66%
Tender Document	Providing FHTC in various GP under JJM in Jal Shakti Section Sh. Naina Devi Ji under JSV Sub-Division Swarghat (Nakrana) Tehsil Sh. Naina Devi Ji District Bilaspur (SH: Construction of sub storage tank of 30,000 litr capacity at village Panjpora and sector storage tank at village Kallari 15000 litr capacity).	0%	0%	2%	38%	27%	18%	13%	0%	3%	97%
	AVERAGE	13%	20%	2%	13%	4%	8%	11%	1%	15%	72%
	Budget spent on materials (in Cr)	72,682	1,13,987	8,738	72,750	24,639	45,652	59,419	3,924		
	Employment generated	13,52,796	21,21,591	1,62,645	13,54,066	4,58,601	8,49,690	11,05,943	73,035		

Appendix 9. Estimated Direct Skilled and Unskilled Labour Employment per 100 Households in Construction Phase of JJM in Different States.

Clusters (Representative States)	**States**	**No. of rural Households**	**Skilled labour employment in construction phase (per 100 household)**	**Total direct skilled labour employment-construction phase**
C1 (Tamil Nadu, Uttar Pradesh, Kerala)	**Tamil Nadu**	12,50806	**1.71**	21389
	Uttar Pradesh	26619580	**2.87**	763982
	Kerala	7068719	**0.30**	21206
	West Bengal	18393602	**1.75**	321888
	Bihar	16629997		291025
C2 (Punjab, Gujarat, Maharashtra, Karnataka, Andhra Pradesh, Jharkhand)	**Punjab**	3425723	**1.13**	38711
	Gujarat	9118449	**0.10**	9118
	Maharashtra	14673332	**0.96**	140864
	Karnataka	10117551	**0.96**	97128
	Andhra Pradesh	9517861	**0.12**	11421
	Jharkhand	6120293	**1.66**	101597
	Telangana	5398219	**0.94**	50743
	Rajasthan	10530458		98986
	Chhattisgarh	5009375		47088
	Madhya Pradesh	11979642		112609
	Haryana	3041314		28588
	Tripura	741945		6974
	Odisha	8863154		83314
C3 (Uttarakhand)	**Uttarakhand**	1494265	**1.27**	18977
	Assam	6802443	**1.27**	86391
	Goa	263013		3340
	Himachal Pradesh	1708705		21701
	Jammu and Kashmir	1909457		24250
	Mizoram	133329		1693
	Nagaland	366001		4648
	Meghalaya	635032		8065
	Manipur	451566		5735
	Arunachal Pradesh	230275		2924
Union Territories	**Andaman and Nicobar Islands**	62037	**1.16**	720
	Dadra and Nagar Haveli and Daman & Diu	85156		988
	Chandigarh	N/A		
	Delhi	N/A		
	Lakshadweep	13,370		155
	Puducherry	114969		1334
Total				**2427553**

Note: i) Total direct employment is the product of 'Total Employment per household' and 'No. of rural Households' ii) total direct employment for the above states are estimated using the average employment-household ratio of the reference states in the respective clusters, iii) clustering of states was done taking into account population density, river length, water body area, ground water availability and worker population ratio of casual labour, iv) Jammu and Kashmir is considered as a state which includes rural household of UT Ladakh v) estimated for UT Chandigarh and Delhi could not be presented due to unavailability of data.

Appendix 10. Estimated Direct Skilled and Unskilled Labour Employment per 100 Households in O&M Phase of JJM in Different States.

Clusters (Ref State)	**States**	**No. of rural household to be covered in JJM period (2019-2024)**	**Skilled employment in O&M phase (per 100 household)**	**Total Direct skilled labour employment post-JJM period-O&M phase**
C1 (Tamil Nadu)	**Tamil Nadu**	1,03,76,744	**0.34**	35281
	Uttar Pradesh	2,61,10,597	**0.34**	88776
	Kerala	54,15,333		18412
	West Bengal	1,82,11,856		61920
	Bihar	1,63,13,988		55468
C2 (Punjab, Gujarat, Maharashtra, Karnataka, Andhra Pradesh)	**Punjab**	17,47,165	**0.51**	8911
	Gujarat	26,02,191	**0.34**	8847
	Maharashtra	98,29,500	**0.76**	74704
	Karnataka	76,65,436	**0.41**	31428
	Andhra Pradesh	64,80,530	**0.56**	36291
	Jharkhand	57,75,128	**0.539**	31128
	Telangana	38,29,918		20643
	Rajasthan	96,27,674		51893
	Chhattisgarh	46,90,159		25280
	Madhya Pradesh	1,06,13,577		57207
	Haryana	12,74,951		6872
	Tripura	7,18,136		3871
	Odisha	85,55,884		46116
C3 (Uttarakhand)	**Uttarakhand**	13,63,953	**0.537**	7324
	Assam	66,91,132		35931
	Goa	63,919		343
	Himachal Pradesh	9,46,002		5080
	Jammu and Kashmir	1332577		7156
	Mizoram	1,23,859		665
	Nagaland	3,55,413		1909
	Meghalaya	6,47,016		3474
	Manipur	4,25,646		2286
	Arunachal Pradesh	2,07,479		1114
Union Territories	**Andaman and Nicobar Islands**	33,490	**0.537**	180
	Dadra and Nagar Haveli and Daman & Diu	85,156		457
	Chandigarh	N/A		
	Delhi	N/A		
	Lakshadweep	13,370		72
	Puducherry	21,463		115
Total				**729156**

Note: i) Total direct employment is the product of 'Total Employment per household' and 'No. of rural Households' ii) total direct employment for the above states are estimated using the average employment-household ratio of the reference states in the respective clusters, iii) clustering of states was done taking into account population density, river length, water body area, ground water availability and worker population ratio of casual labour, iv) Jammu and Kashmir is considered as a state which includes rural household of Ladakh UT, v) estimates for UT Chandigarh and Delhi could not be presented due to unavailability of data.

Appendix 11. Scheme Level Factors Affecting Employment Generation: Results from Regression Analysis.

DV (Emp_per_100HH)	**Coefficients**
Scheme type: SVS (Ref: MVS)	0.067 (0.209)
Implementation phase: O&M (Ref: Construction)	-0.679*** (0.131)
Nature of scheme: New scheme (Ref: Retrofitting)	0.002 (0.282)
Total Population (ln)	-0.633*** (0.106)
Cost per capita (ln)	-0.074 (0.072)
R^2	**0.439**

Note: i) Results are adjusted for state level fixed effect ii) Robust standard error are presented in parenthesis. iii) *** represents significance level at 1%.