

Working Paper 2016/02

**Socio-Economic Impact of  
Tarakpur Check Dam in Khambhat Area of Gujarat**

*S. S. Kalamkar, H. P. Trivedi,  
S. R. Bhaiya and D. J. Chauhan*

October 2016



**Agro-Economic Research Centre**

*For the States of Gujarat and Rajasthan*

(Ministry of Agriculture & Farmers Welfare, Govt. of India)

**Sardar Patel University**

**Vallabh Vidyanagar, Dist. Anand, Gujarat**

---

Working Paper 2016/02

# **Socio-Economic Impact of Tarakpur Check Dam in Khambhat Area of Gujarat**

**S. S. Kalamkar, H. P. Trivedi,  
S. R. Bhaiya and D. J. Chauhan**



**Agro-Economic Research Centre**  
*For the States of Gujarat and Rajasthan*  
( Ministry of Agriculture & Farmers Welfare, Govt. of India)

**Sardar Patel University**  
Vallabh Vidyanagar, Dist. Anand, Gujarat

**October 2016**

---



AERC Working Paper 2016/02


© Agro-Economic Research Centre, Vallabh Vidyanagar 388120, Dist. Anand, Gujarat, India.

***About the Centre:***

The Agro-Economic Research Centre (AERC) for the states of Gujarat and Rajasthan was established in July 1961 at the Sardar Patel University, Vallabh Vidyanagar by the Directorate of Economics and Statistics, Ministry of Agriculture, Government of India, New Delhi. AERC has been working as an associate institution of S. P. University and enjoying autonomy status in its working. The Centre has completed 55 glorious years (1961-2016) of its journey marked by both achievements and challenges. During these years, the Centre has emerged as a strong policy feedback centre of the Ministry of Agriculture, Government of India due to hard work and strong commitment of the staff in the Centre. The focus of research effort in the initial stage was on comprehensive village surveys and resurveys in order to understand the process and direction of change at the village level. Subsequently, the emphasis of research has shifted to problem oriented studies. The Centre has by now completed 167 problem-oriented studies, 21 village surveys and 4 village resurveys. During its long journey, the Centre has brought remarkable improvement in every aspects of research including methodological base of the studies. The studies have come out with useful findings and policy implications for agricultural and rural development of the states of Gujarat and Rajasthan.

***Working Paper Series:***

The Working Paper Series provides an opportunity for AERC and CCS faculty/staff, invited guest speaker, visiting fellows and Ph.D. scholars to discuss their ideas and research work before publication and to get feedback from their peer group. Papers selected for publication in the series present empirical analyses and generally deal with wider issues of public policy at a sectoral, regional or national level. These working papers undergo review but typically do not present final research results, and constitute works in progress.



# Socio-Economic Impact of Tarakpur Check Dam in Khambhat Area of Gujarat\*

S. S. Kalamkar<sup>1</sup>, H. P. Trivedi<sup>2</sup>, S. R. Bhaiya<sup>3</sup> and D. J. Chauhan<sup>4</sup>

## *Abstract*

*The study was undertaken with an aim to evaluate the change in socio-economic status of the people in the selected villages in Khambhat area of Gujarat before and after the construction of check dam. The study results clearly indicate a strong support to the benefits perceived from the construction of checkdam. The significant impact of availability of check dam water could be easily seen on the livelihood of beneficiary households through positive changes in land and livestock holdings, increase in crop yield and level of income, reduction in migration patten, etc. Though there are some negative effects which can be easily offset by the benefits of checkdam. Also with the benefits of checkdam, the problems can be taken care. Besides irrigation, water has many other uses such as drinking, bathing and washing. Also due to increase in production and productivity of crops, there was increase in income of farmer as well as agriculture labours which works as catalyst and as a multiplier effect in the development of economy of the selected villages. Thus, this kind of project should be taken up by the local authorities to help the farmers and labours to enhance their livelihood.*

*Keywords: Socio-Economic Development, Checkdam, Water, Livelihood, Rural Development*

*JEL Codes: O12, O13, Q12, Q25*


## **1. Introduction**

Water is an essential natural resource for human life. India is facing major crisis of water as we move into 21<sup>st</sup> century. This crisis threatens the basic right of drinking water of our citizens; it also puts the livelihoods of million at risk. The demands of a rapidly industrializing economy and urbanizing society come at a time when the potential for augmenting supply is limited. Climate change posed fresh challenges with its impacts on the

\* This is abridged version of research project carried out for Petlad Irrigation Department, Govt. of Gujarat, Anand. Authors thank anonymous referee for his constructive comments.


<sup>1</sup> & <sup>3</sup> Director and Field Officer, Agro-Economic Research Centre, Sardar Patel University, Vallabh Vidyanagar.

<sup>2</sup> & <sup>4</sup> Professor, PG Dept. of Economics, Sardar Patel University, Vallabh Vidyanagar.



hydrologic cycle. Resilience of eco-systems needs, therefore, to become a central plank of policy (Shah, 2013). In most of the semi-arid regions of India, inadequate availability of water is the most limiting factor in agricultural and rural development. Those regions receive, on average, 400 mm to 1,000 mm rainfall annually, which if harvested and used judiciously, could support a higher cropping intensity than the existing one (Jagawat, 2005). The check dam is one such example of water harvesting.

Though most of the parts of the country have abundance of water in rainy season, but have lack of water in dry season. These states/regions are making attempt to preserve the natural water from rainy season up to dry season by 3 levels of natural water preservation. First level of water preservation quite adopted as permanently structure or dam (biggest preservation). Although dams provide a variety of economic goods and services, including electric power, flood control, water supply, reservoir recreation, and navigational services, they also have detrimental effects on riverine ecosystems (Pett, 1984; Aini, 2007; Shieh and Guh, 2007; Saranrom, 2011). Second levels of the natural water preservation also named as dam but smaller size structure are semi-permanently building and the third levels of the natural water preservation known as check dam or smallest dam or temporary dam and so on. Check dam is the construction or small barrier that lay across the stream of water flow, constructed of rock, gravel bags, sandbags, fiber rolls, or reusable products, placed across a channel, small river, constructed swale or drainage ditch for the purpose of water harvesting (Khosla, 1999; Balooni, et al., 2008; CSQA, 2003). They are made either of temporary materials such as brush, poles, wire and loose rock or more permanent masonry materials (Rao, 2000). This study will remain focused on the latter type of check dam. The check dam serves mainly five purposes such as (i) to provide direct irrigation, (ii) to prevent rain water from flowing always into the sea, (iii) reduce or mitigate the speed of the water stream; (iv) reduce soil erosion and trap sediments; and (v) facilitate the recharging of surrounding wells through percolation of water (Zhou, et al. 2004; Lin, et al., 2008; Zeng, et al., 2009; Hassanli and Nameghi, 2009). There are numerous additional advantages to the dam structure such as affecting the flood-load deposit during Kharif, decreasing the erosive force of water and increasing the contact time of water with land surface (Murty, 1994). Such outcomes ultimately increase the recharge of rainwater into the ground, extending and maximizing the time available to make use of monsoon rain. Check dams are the most effective tool for water conservation at the minimum investment, minimum maintenance and operational cost. Check dams do not require land acquisition and hence most of the legal complications are avoided in the




whole process. Moreover the advantages are made available to the beneficiaries instantly. Because of low cost of check dams, poor farmers can also participate (<http://guj-nwrws.gujarat.gov.in>).

The relative significance of traditional minor irrigation sources for agricultural development in India is well known (Sivasubramaniyan, 1994). Check dams suit Indian conditions, where a large number of seasonal streams completely dry up during summer. The success of such collective traditional water harvesting systems in ensuring sustainable water supply in different parts of India has gained the interest and promotion of the Government of India. The National Water Policy, 2002 of India recommends the revival of traditional water harvesting systems to increase utilizable water resources (MOWR, 2002). Such policy measures are gaining acceptance due to the realization that major and medium irrigation projects constructed in the past and managed by government agencies have invited criticism on economic and ecological fronts (Engineer, 1990; Kothari, 1998; Paranjpye, 1990; Sharma, 1999; Nair, 2002; Raghunath, 2003). Traditional water harvesting systems enhance the water status of a country and contribute to achieving sustainable development (Balooni et al., 2008). A brief review of the studies conducted in India and abroad indicated positive impact of check dam on livelihood (Mudrakartha, 2003; Palanisami et al., 2006; Neumann et al., 2004; Arya and Yadav, 2006; Gale et al., 2006; Somwanshi et al., 2006; Ashraf et al., 2007; Balooni, et al., 2008; Fromant, 2009; Khlif, et al. 2010; PHDRDF, 2011). Palanisami et al. (2006) assessed the effect of artificial recharge by check dam in the hard rock region of Coimbatore, Tamil Nadu, India and found that greater impact of check dam in the case of wells located within 64m from the check dam. Khanna (1996) noted some negative impacts but positive benefits largely outweigh these. The reviews indicated that water harvested by the check dams has increased the income and changed the livelihood mainly due to sustained agriculture.

## **2. Tarakpur Village Check dam**

Water-harvesting systems were significant developed from ancient times in urban areas and rural areas of some of the most arid and water stressed regions of the country such as Kutch and Saurashtra in Gujarat and Western Rajasthan (Agarwal and Narain, 1997). Rain water harvesting through Check dams in the Khambhat region of south Gujarat is imperative to ensure urgent need of water for drinking and irrigation purposes. This method is an efficient measure to tackle the need of water for drinking purpose and



irrigation as ground water is salty in nature. About two kilometres away from the Tarakpur village, the Kharland Board has constructed 34 gates in the past in order to control the salty sea water penetration/saturation in this area. However, as these structure/gates proved to be ineffective over time, they have become inactive. Consequently, the salty sea water gradually covered all the groundwater area of Pandad village and surrounding villages and other areas of Kambhat. Subsequently, the level of salty water table took over groundwater table which affected the prime source of their livelihood, i.e. agriculture activity of all the villages. Some of the villages such as Vadgam, Tarakpur, Pandad, Rohini and Mitali of the Khambhat tehsil of Anand district are located in remote and interior areas. There was no other source of irrigation for the agriculture in these villages. The rural people of these villages had suffered and the situation forced them to migrate during the rabi and summer seasons. In light of the above, the villagers had demanded to construct the check dam on Navida kanch/ valley/nala. The rain water and water drain of irrigation otherwise merges with the seas in the form of runoff without any use. As per the public demand for check dam for the purpose of drinking water and irrigation from the Khambhat area of Anand district, the Check Dam was constructed by the Pelted Irrigation Department, Petlad in 2009. The main purpose of check dam is (i) to store sweet water for drinking and irrigation purpose; and (ii) to restrict the salty water at surrounding area of the Tarakpur village and the coastal area. It had been reported that after construction of check dam, the area under irrigation has increased significantly in surrounding areas and in many cases helped to increase the productivity of land and in turn to increase the agricultural production in the villages. The consequent rise in the income level of farmers has reversed the migratory trends of the villagers to urban areas and has promoted sustainable development. In order to check the real ground reality about the impact of checkdam, as desired by the Irrigation Department, Petlad, the present study was undertaken with an aim to evaluate the change in socio-economic status of the people in the selected villages before and after the construction of check dam.

### **3. Data and Methodology:**

The study is based on both primary and secondary data. The secondary data were collected from the published sources, irrigation department office and related websites. The data on the demographic characteristics of selected villages, taluka and district were downloaded from the Census of India

website (<http://censusindia.gov.in/>). The primary data<sup>5</sup> were collected from selected sample farmers from five villages, viz. Tarakpur, Pandad, Mitali, Vadgam, Rohini. In order to know total number of beneficiaries of the checkdam and distribution of land holdings in selected villages, a village census was carried out in selected five villages<sup>6</sup>. As per the proportion of beneficiaries, non- beneficiaries and agricultural labour households in total households in respective village, the number of sample farmers/labours were drawn to make total sample of 300 households comprising of 200 beneficiary farmer households, 50 non-beneficiary farmer households and 50 landless agricultural labour and other households (Table 1). Besides formal survey through filling up of schedules, informal group discussions with beneficiaries and non beneficiaries were also held. The conscious efforts have been also made to get the views of landless labours and women. The required data have been collected by canvassing a pre-designed and pre-tested schedule (done in December 2013) in 2014 covering before check dam and after checkdam period as: (a) before check dam- agriculture year 2008-2009 & (b) after checkdam - agriculture year 2012-2013.

Table 1: Selected Number of Sample Households

Sr. No.	Village	Beneficiaries Households	Non Beneficiaries households	Agricultural labours and others	Total
1	Tarakpur	40	00	04	44
2	Rohini	25	13	07	44
3	Pandad	49	11	04	64
4	Vadgam	50	09	24	84
5	Mitali	36	17	11	63
	Total	200	50	50	300

The proportion of selection of sample households under each stratum was done as per its share in total number of farmers in the particular holding size exists. The number of beneficiaries and non beneficiary farmer households were further divided into five strata as per actual operational land holding size (reference year 2012-13), viz. marginal (less than 1 ha), Small (1-2 ha), Semi-Medium (2-4 ha), Medium (4-6 ha) and Large (above 6 ha) (Table 2). Other than farmer households, data were collected from indirect beneficiaries such as landless agriculture labours/rural artisans, etc. The

<sup>5</sup> The field visits were conducted to selected villages and check dam on August 16, 2013 and November 26, 2013 and group discussions were held in selected villages to know about the check dam and its impact.

<sup>6</sup> The census of all selected villages was carried out in two phases in the month of December 2013.



simple tabular analysis was carried out to know the change in various parameters related to livelihood in the selected villages.

Table 2: Distribution of Beneficiary & Non beneficiary Farmers Households as per Land holding size

Sr. No.	Village	Distribution of farmer households as per land holding size				
		Marginal	Small	Semi Medium	Medium	Large
1	Total Beneficiary	49	51	37	30	33
		(24.5)	(25.5)	(18.5)	(15.0)	(16.5)
2	Total non-beneficiary	16	12	10	06	06
		(32.0)	(24.0)	(20.0)	(12.0)	(12.0)

Note: Figures in parenthesis are percentage to total selected households in village.

#### 4. Findings from Field Survey data

##### 4.1 Socio-Economic Characteristics of Sample Households

The socio-economic characteristics of selected households indicate that the selected beneficiary households average age was around 50 years having farming experience of about 23 years, almost all decision were taken by male, except few households in small farm category where female played lead role in decision making. More than 75 percent head of households were educated and about 99 percent of households had agriculture as their main occupation (Table 3). The dairy and agriculture labour was the secondary occupation of the selected beneficiary households. The social classification of selected beneficiary households indicates the dominance of SEBC followed by General and SC category households. It further validates our selection of sample beneficiary households from all social category representation. Out of the selected beneficiary households, two third households were covered under benefits declared by the government for the households classified under below poverty line. In case of non-beneficiary households as well, the average age of the head of the households was around 50 years with farming experience of more than 23 years. The literacy rate was around 54 per cent and dominance of male decision maker could be seen in this category also. All other characteristics pattern found similar in non beneficiary as seen in beneficiary household. In case of landless agriculture labour that the average age of head of household was around 42 years of which about 40 percent households heads were literate. The selected

household head was having working experience as agriculture labour of 15 years, with dairy as a subsidiary occupation. It was very surprising to note that out of total selected SC category households, about 28 percent were reported to be above poverty line, whereas only 25 percent households from the general category were classified under this category. The household profiles of all selected households indicate that average size of selected beneficiary and non beneficiary family households was of six members whereas agriculture labour households was relatively smaller of about five member. The average age of households was between 25-30 years. The average education level of all family members of all selected households was around up to fifth standard.

Table 3: Household characteristics of selected sample farmers

Sr. No.	Particulars	Household Characteristics	
		Beneficiary	Non-Beneficiary
1	Age of the House head (years)	50.16	50.64
2	Age of the decision of makers (years)	50.16	50.64
3	Gender of Decision maker (%)		
	i) Male	99.0	100
	ii) Female	1.00	0
4	Education of decision maker (years)		
	i) Illiteracy	23.00	46.0
	ii) Educated	77.00	54.0
5	No. of years of farming experience	23.47	23.6
6	Occupation- Main (% to total)		
	i) Crop farming	99.00	100.00
	ii) Dairy	1.00	0.00
7	Occupation- Subsidiary (% to total)		
	i) Dairy	65.00	52.00
	ii) Agri labour	24.50	40.00
	iii) Service	4.00	2.00
	iv) Other	6.50	4.00
8	Income -all Sources (Rs) 2012-13	202379	121930
9	Social Group (% to total)		
	i) SC	25.50	30.00
	ii) ST	0.00	0.00
	iii) SEBC	48.50	40.00
	iv) Open	26.00	30.00
10	Ration Card (% to total)		
	i) APL	66.00	66.00
	ii) BPL	33.50	34.00
	iii) AAY	0.50	0.00

## 4.2 Socio-Economic Impact of Check dam


### 4.2.1 Changes in Land Ownership & Operational Holdings

The selected farmers have reported marginal increase in area as owned land and operational holdings after check dam, however, reverse trend was observed in land leasing pattern (from leased-out to land leased-in). Though increase in owned land was meagre, the operational land holding has increased by about 3.4 percent (Table 4). Thus, check dam has facilitated to take additional land for cultivation on lease-in due to availability of water. However in case of non-beneficiary households, it was observed that owned land holdings has declined in case of marginal farmer by about 28 percent as well as in case of large farmer by about 6 percent. The land leased-in pattern which was prominent before check dam got weaken after construction of check dam. This must have happened due to non-willingness to leased-out land by farmer in view of availability of water.

Table 4: Changes in Land Ownership Pattern of Selected Households after checkdam

Sr. No	Particulars	Changes in Land Ownership pattern- % Increase/Decrease after Checkdam over before check dam					
		Marginal (M)	Small (S)	Semi-Medium (SM)	Medium (ME)	Large (L)	Total /AV
A	Beneficiary hh						
1.	Owned land	1.54	0.00	0.00	0.00	0.00	0.07
2.	Fallow land	-	-	-	-	1150.0	212.65
3.	Leased-out land	50.00	83.33	60.00	-	107.69	110.49
4.	Leased-in land	3.11	2.79	1.55	2.63	4.59	3.55
5.	Operational Holding	0.63	1.27	2.45	5.06	10.35	3.40
B	Non-beneficiary hh						
1.	Owned land	-27.6	0.0	0.0	0.0	-6.2	-5.0
2.	Fallow land	-	-	-	166.7	-	166.7
3.	Leased-out land	-	-	-	-	-	-
4.	Leased-in land	133.3	-	-	-	-	1400.0
5.	Operational Holding	-23.5	7.7	3.3	-7.9	-2.1	-3.3

Source: Field Survey data.



It can be observed from the Table 5 that the check dam has facilitated agriculture in the selected villages, which is evident from the increase in area under irrigation. The irrigated area (area with protective irrigation) to total operational holdings has increased significantly in all size of farm categories and specifically marginal and small farmers who have benefited heavily with the check dam in both the categories. On an average, more than 94 percent land of beneficiary households was under irrigation after check dam, while corresponding figure before construction dam was 24 percent. In case of non-beneficiary household, it has increased from 48 percent to 70 percent during corresponding period. It can be also seen from these tables that increase in gross cropped area was significant to the extent of about 37 percent in case of beneficiary households whereas corresponding increase was about 16 percent in case of non beneficiary households. Also significant increase has been recorded in cropping intensity. The increase in area sown more than once has increased the cropping intensity of beneficiary households by about 46 percent point, whereas it has increased by 26 percent point for non-beneficiary household. Thus, it very clearly indicates the benefit of checkdam water and its impact on putting more land under cultivation in a year. In case of non-beneficiary households, except large farmer group (where area under irrigation has declined), proportion of irrigated area (to operational holdings) has increased, which may be due to availability of canal water as beneficiary households availed benefit of check dam water.

The data on sources of irrigation presented in Table 6 shows that in case of beneficiary households, before checkdam, more than two third of land was without any protective irrigation facility whereas remaining land was covered with canal water. However, after construction of checkdam, the water available through checkdam became major source of irrigation with the supplementary support of canal and farm pond. Thus, it clearly indicated the benefit of water through check dam to the selected sample beneficiary households. However, in case of non-beneficiary households, most of the farmers did not have protective irrigation facility. Those who had it, their main source of protective irrigation were farm pond or tubewell /shallow well. Though the percentage of farmers having irrigation water coverage has increased, their main source remains same, i.e. canal followed by river. In some case, water from farm pond was also used to irrigate the crop.

Table 5: Changes in Irrigated Area, GCA & Cropping Intensity

Sr. No	Particulars	Changes after Check dam (%)					
		M	S	SM	ME	L	AV
A	Beneficiary hh						
i	Increase in Irrigated area (% points)	76.33	78.93	73.16	71.45	67.29	70.40
ii	Increase in Gross Cropped Area- GCA (%)	29.31	30.46	39.36	39.27	37.44	36.95
iii	Increase in Cropping Intensity (% point)	40.1	40.7	52.3	50.5	45.0	46.4
B	Non-beneficiary hh						
i	Increase in Irrigated area (% points)	48.09	23.09	38.69	38.16	-0.75	21.57
ii	Increase in Gross Cropped Area- GCA (%)	29.80	27.20	25.00	29.40	0.00	15.90
iii	Increase in Cropping Intensity (% point)	75.9	28.9	27.3	45.5	3.0	25.9

Source: Field Survey data.

Table 6: Sources of Irrigation for Selected Households

Sr. No.	Particulars	Sources of Irrigation (Multiple)			
		Before Dam		After dam	
		Beneficiary	Non-Beneficiary	Beneficiary	Non-Beneficiary
1	Not Available	73.5	48.0	0.0	28.0
2	Canal	23.0	36.0	24.0	52.0
3	Checkdam	-		100.0	
4	Farm pond	0.5	0.0	3.00	4.0
5	River	3.0	0.0	0.0	0.0
6	Tank	0.0	16.0	0.0	16.0

Note: Figures are percentage to total number of households. In case of multiple sources of irrigation, total percentage exceeds 100.

Source: Field Survey data.

The data on terms of lease was collected to know its pattern. It was observed land was leased-in/out mostly on rent in kind ranged from 33-50 percent of output. There were few cases who had leased in/out land on girvi<sup>7</sup> basis as well as on rent in cash (for one year). It was also observed that as mentioned earlier, as compared to before check dam situation, more land was taken on leased-in basis after construction of check dam. In case of non-beneficiary households also, same trend has been noticed. The reasons for leasing-out and leasing-in land during both the periods mentioned by the selected beneficiary farmers were that land leased-in pattern has increased considerably after check dam as compared to before checkdam mainly due to availability of water, whereas land leased-out tendency has come down also

<sup>7</sup> Girvi- Type of renting land on lumpsum amount for a period of three to five years.

due to availability of water through checkdam (Table 6). The reasons for leasing-out the land were identified as, lack of resources (e.g. irrigation etc.); risk sharing; distance to the plot; non-availability of water for irrigation; left villages/shifted to another place; and salinity problem (Table 7). Whereas the reasons quoted by the selected farmers towards leasing-in land were less land for cultivation; availability of water for irrigation; and to make use of the available resources. Though the selected study area is located close proximity to the sea shore and thus available groundwater is of salty in nature, attempt was made to know the water availability for home consumption (bathing, utensils cleaning, cloth washing, drinking, cleaning of animals and other home uses) purpose in both the periods. The households still depend heavily on public pipeline, river and rainwater (during rainy season) for drinking water. Thus, there is an urgent need to take steps on storage of rainwater and its supply to these selected villages through proper management and distribution system.

Table 7: Reasons for Leasing-out / Leasing-in the Land by Selected Household (Beneficiary and Non beneficiary)

Sr. No	Particulars	Reasons for Leasing-out /Leasing in the land			
		Beneficiary hh (%)		Non-beneficiary hh (%)	
		Before check	After check	Before check	After check
A	Land leased-in				
1	Less land for cultivation	70.0	75.0	100	100
2	Availability of water for irrigation	30.0	100.0	-	75
3	To make use of the available	30.0	60.0	-	100
4	Risk sharing	10.0	5.0	-	-
	Distance to the plot	10.0	5.0	-	-
B	Leased-out	T (n=2)	T (n=2)		
1	Lack of resources (e.g. irrigation	100.0	100.0	-	-
2	Risk sharing	50.0	100.0	-	-
3	Distance to the plot	0.0	0.0	-	-
4	No Availability of water for irrigation	100	100.0	-	-
5	Left villages/shifted new place	0.0	0.0	-	-
6	Salinity problem	0.0	0.0	-	-

Notes: n= number of observations, Figures are percentage to no. of observations, multiple answers therefore total exceeded hundred.

Source: Field Survey data.

## 4.2.2 Changes in Livestock Holdings

The data were collected on the number of animals with selected sample households before and after the dam and are presented in Table 8. It was observed that in case of beneficiary households, significant growth has been recorded in number of livestock holdings with these households such as cow, buffalows, calf and goat after construction of check dam, whereas number of bullocks have declined in all cases (beneficiary, non-beneficiary and landless agricultural labour households) which may be due to rapid mechanisation in agriculture, i.e. increase in number of machinery such as tractors, threshers, etc. The increase was more prominent in number of goat and calf in selected beneficiary households. Of-course, there was also increase in milk production due to increase in number of milch animals. Thus, increase in number of livestock and milk production can be attributed to the availability of water for drinking and irrigation purposes and thus, increase availability of fodder in this area.


Table 8: Changes in Livestock Holdings of Selected Households (Beneficiary and Non Beneficiary hh)

Sr. No.	Particular	% Increase/Decrease in total number- after Checkdam over before		
		Beneficiary hh	Non-beneficiary hh	Agri Labour
A	Cow			
1	No. of cows/hh	24.5	-16.7	-
2	No. of milch cows/hh	14.1	12.5	-
3	Milk prod/hh (Lit/day)	17.0	42.1	-
4	Milk Rate (Rs./Lit)	85.1	71.9	-
B	Buffalo			
1	No. of buffalo/hh	38.5	64.3	114.3
2	No. of milch buffalo/hh	26.1	8.3	57.1
3	Milk prod/hh (Lit/day)	8.5	26.4	-3.3
4	Milk Rate (Rs./Lit)	65.3	79.1	48.5
C	Calf/hh Total Calves	120.8	180.0	100
D	Bullock/hh	-93.9		100
E	Goat	300.0		

Source: Field Survey data.

## 4.2.3 Changes in Income Level

Due to changes in the different parameters related to agriculture mainly because of availability of water through check dam, it was expected that there must be a change in level of income of the selected sample beneficiary



households. The selected farmers have mentioned that due to check dam, the annual income level has increased significantly over the years. About 97 percent sample beneficiary households have experienced increase in income level. No change in income was recorded in two cases and in three cases, it has declined. The declined in income of some farmers after checkdam was mainly due to sale of land, crop failure and some other reasons. It was very surprising to note that in all the cases of non-beneficiary households as well, there was significant increase in level of income. In case of agriculture landless labours as well, more than 90 percent households have reported increase in income level after check dam (for details, please see full report, Kalamkar et al., 2014).

#### **4.2.4 Changes in Availing Education Facility Status**

The availability of income determines the status of schooling of children. In case of low income group families, generally women and children also need to earn wages to support family. Thus, with low income and for support of family, children get deprived from their schooling education. The data were collected from the selected households to know about the changes in the status of family in providing the basic education facility to the children. The results indicate that as compared to the situation before checkdam, post checkdam situation indicates that all eligible children were provided their basic right of education by their family. This shift must be due to increase in income level due to check dam. The major effect of increase in income on education could be seen from the significant increase in enrolment of the female eligible students. Thus, changes in socio-economic status of the selected households due to checkdam water availability facilitated the education level in the selected area which would in turn change the future of the families further (for details, please see full report, Kalamkar et al., 2014).

#### **4.2.5 Agriculture/Livestock Loan**

The details of agriculture and livestock loan taken by the selected households indicate that before checkdam, out of total selected beneficiary farmers, 14 percent farmers had taken loan from bank (cooperative and scheduled commercial banks), which has increased to 30 percent in the year 2012-13. Among the farm categories in beneficiary households, except marginal farmer, significant increase has been registered in number of farmers availing benefit of agricultural and livestock loan. Needless to mention here is that due to increase in income level (due to water availability)



resulted in assurance of crop income made bankers to positively lend the loan to these farmers, mostly for the mechanisation of agriculture (i.e. purchase of tractor, thresher, harvester and oil engine). The same trend could be noticed in case of non-beneficiary households as well. Whereas only one landless agriculture labours household had taken livestock loan from SCB for the purchase of livestock (for details, please see full report, Kalamkar et al., 2014).

#### 4.2.6 Changes in Land Rate

Due to availability of water for irrigation, drinking and other purposes, the land value in the selected villages has accelerated positively during the recent past. It can be seen from the Table 9 that in case of beneficiary households, the irrigated land rate has increased by almost five times from about Rs. 62000 per bigha in 2008-09 to Rs. 326000/bigha in 2012-13. Whereas rainfed land rate has gone up by more than four times, from Rs. 40000/bigha to Rs 215000/bigha during corresponding years. The land rates have increased at higher rate during 2010-11 and 2011-12 as compared to other years. In case of non-beneficiary households also, the land rates have increased significantly. Even someone try to take out effect of inflation on land prices, a clear cut impact could be seen on the land rate due to check dam and changes in socio-economic conditions of villages.

Table 9: Changes in General Land Rate

(Lakh Rs./bigha)

Sr No	Year	General Land Rate (Lakh Rs./bigha) Beneficiary Households					
		Irrigated (Beneficiary)			Rainfed (Beneficiary)		
		Total	Yearly % change	%age change over base	Total	Yearly % change	%age change over base
1	2008-09	0.62	-	-	0.40	-	-
2	2009-10	0.98	58.2	58.2	0.62	56.5	56.5
3	2010-11	1.62	64.6	160.3	0.97	56.7	145.2
4	2011-12	2.35	45.7	279.3	1.54	58.4	288.4
5	2012-13	3.26	38.3	424.6	2.15	39.7	442.5

Note : 1 ha= 4.17 bigha

Table 9: Continued...

Sr No	Year	Irrigated (Non-beneficiary)			Rainfed (Non-beneficiary)		
		Total	Yearly % change	%age change over base	Total	Yearly % change	%age change over base
6	2008-09	0.50			0.32		
7	2009-10	0.81	62.7	38.5	0.56	72.9	42.2
8	2010-11	1.42	76.3	114.9	1.01	81.7	123.9
9	2011-12	2.38	67.3	233.6	1.71	68.5	248.4
10	2012-13	3.54	48.8	377.6	2.55	49.0	398.4

Source: Field Survey data

#### 4.2.7 Changes in Holdings of Land, Livestock & Implements, Productive and other Assets

The information regarding purchase and sale of agriculture land, livestock and implements by selected households made it clear that the farmers had purchased quite a significant number of animals, land and agricultural implements. This could happen only because of availability of water in the study villages by check dam and thus increase in income. There was significant increase in holding of mechanical implements such as tractor, diesel pump, pipeline and other implements. Also changes could be noticed in the holdings of house and other assets. In both the cases, the number of bullock carts has declined drastically due to purchase of mechanical implements by the farmers such as tractor, thresher. Among the other assets, radio and bicycle are getting out of the lifestyle of villagers due to rapid linking of villages to town and cities and adoption of luxuries culture (for details, please see full report, Kalamkar et al., 2014).

#### 4.2.8 Changes in Cropping Pattern

The changes in cropping pattern of selected households after construction of check dam indicate that the major crops cultivated before the construction of check dam were paddy and wheat (Table 10). After the checkdam, the crop growing sequence has not changed much, however, the area share (to GCA) of paddy has increased significantly whereas area share under wheat has declined. Among the kharif season crops, share of area under jowar crop has slightly increased which is generally grown for fodder purpose only. Whereas share of area under commercial crop i.e. cotton has declined over the period of time. Thus, availability of water as protective irrigation

and assured harvest of paddy takes over the cropping pattern. As seen earlier, due to check dam water, farmers could put more land under cultivation which has increased the cropping intensity significantly. Besides this, the production of crops has increased significantly.

Table 10: Changes in Cropping Pattern of Selected households (Beneficiary & Non Beneficiary)

Sr. No.	Crop	Cropped area percentage to Gross Cropped Area (%) 2012-13 \ over 2006-07			
		Beneficiary hh		Non-beneficiary hh	
		2012-13	% change	2012-13	% change
1	Paddy	47.8	16.9	47.66	8.56
2	Jowar	0.4	0.1		
3	Cotton	0.3	-0.7		
A	Kharif Total	48.5	16.3	47.66	8.56
4	Wheat	48.6	-17.3	51.38	-8.27
5	Gram	2.9	1.1	0.96	-0.28
6	Cumin	0.0	0.0		
7	Other	0.0	-0.1		
B	Rabi Total	51.5	-16.3	52.34	-8.56
C	Summer Total	0.0	0.0	0.0	0.0
D	GCA	100.0	0.0	100.0	0.0

Source: Field Survey data

Among both the categories of farmers (BHH and NBHH), the significant increase has been recorded in area share under paddy crop, whereas area share under wheat crop has been declined in all categories of land holdings. To some extent gram crop area share has increased in case of beneficiary household, where same has declined in non-beneficiary household. The reason behind no diversification in cropping pattern in selected area may be due to peculiar nature of soil and weather, which is more suitable to cultivate paddy, wheat, gram and some extent jowar crop. Thus, instead of cropping pattern, one can expect the changes in crop yield of these crops after availability of water.

#### 4.2.9 Changes in Crop Yield

The significant changes could be seen in case of yield levels of crops the selected farmers (Table 11). Most of the farmers have reported that besides

the assurance of crop production, the average yield level of all the major crops have increased after the construction of checkdam. The average yield level of irrigated paddy increased by around 23 percent in TE 2012-13 over TE 2008-09, while average yield level of irrigated wheat increased by 42 percent. Whereas average yield level of rainfed paddy increased at lower rate by around 15 percent and rainfed wheat yield level increased by around 4 percent or so. Across the farm size group, highest growth in yield level could be noticed in case of semi-medium followed by marginal and medium farmer group. The noticeable increase was recorded in case paddy yield levels in both beneficiary and non-beneficiary households. In case of wheat crop, it was observed that the yield levels were lower during before dam period of non-beneficiary households, due to which after dam increase in yield of wheat level was higher in non beneficiary household than beneficiary households. However, in both the cases, yield level increase was significant. It may be worth to mention here is that wheat production during rabi season is rainfed (bhal wheat known for rainfed wheat which has very high demand in local market). Thus, no matter whether water is available for irrigation or not. Thus, the changes in yield could be noticed in case of paddy only.

Table 11: Changes in Yield of Major Crops of Selected Households (Beneficiary and Non beneficiary hh)

Irrigated/ Rainfed	HHs	Changes in Yield of Major Crops TE 2012-13 over TE 2008-09			
		Beneficiary hh		Non-beneficiary hh	
		Paddy	Wheat	Paddy	Wheat
With supportive irrigation	MF	23.02	98.04	22.9	79.2
	SF	3.48	12.67	-19.0	93.1
	SMF	44.19	43.55	52.8	32.9
	MDF	22.25	33.72	47.7	120.8
	LF	19.02	42.76	9.2	40.2
	AV	22.42	41.89	13.5	66.7
Rainfed	MF	4.18	-1.64	-1.0	74.3
	SF	24.46	-24.79	53.3	59.5
	SMF	40.68	23.95	43.7	27.0
	MDF	8.72	-1.25	60.0	28.7
	LF	19.58	9.83	8.3	14.8
	AV	14.85	3.36	27.2	45.1

Source: Field Survey data

#### 4.2.10 Changes in Input Use

The changes in input use after construction of checkdam by beneficiary households are presented in Table 12. It can be seen from the table that all farm size category farmers have opined that overall use of inputs have increased after the construction of check dam. The significant increase has recorded in case of fertiliser, human labour use, machinery use, number of irrigation and use of diesel and ultimately resulted in increase in labour cost. The reduction in use is recorded in case of bullock labour (which may be due to increase in machinery labour) and in some cases use of local/desi seed. In case of non-beneficiary households as well, significant increase in use of inputs has been noticed. After check dam, the beneficiary households could irrigate the crop more times than non-beneficiary households. As discussed earlier, before check dam the major source of irrigation for beneficiary households was canal followed by farm pond and river. After construction of checkdam, check dam water became main source of irrigation. The most of water used was lifted through pipeline from the nearby water source.

Table 12: Changes in Input Use (Overall) by Selected Households

Particulars	Extent of change in use	Changes in input use (% of responses to total)					
		MF	SF	SMF	MDF	LF	Total
Beneficiary hh	Large increase (>25%)	30.6	23.5	27.0	10.0	36.4	26.0
	Increase (up to 25%)	61.2	49.0	62.2	66.7	51.5	57.5
	No Change	8.2	23.5	10.8	23.3	12.1	15.5
	Decrease (up to 25%)	0.0	3.9	0.0	0.0	0.0	1.0
	Large Decrease (>25%)	0.0	0.0	0.0	0.0	0.0	0.0
Non-Beneficiary hh	Large increase (>25%)	18.8	16.7	20.0	0.0	16.7	16.0
	Increase (up to 25%)	43.8	41.7	40.0	66.7	50.0	46.0
	No Change	37.5	41.7	40.0	33.3	33.3	38.0
	Decrease (up to 25%)	0.0	0.0	0.0	0.0	0.0	0.0
	Large Decrease (>25%)	0.0	0.0	0.0	0.0	0.0	0.0

Source: Field Survey data



#### **4.2.11 Changes in Wages and Rental Charges**

The majority of the households have mentioned that wages and rental charges for agriculture operations have increased after construction of checkdam. The availability of water and work on field has increased the demand for human and machine labour, thus wages rate must have gone up due to same (for details, please see full report, Kalamkar et al., 2014).

#### **4.2.12 Changes in Status of Migrations**

The majority of households have reported that before construction of dam, some family members were compelled to migrate to some other places in search of work so that they can get some income for meeting running household expenditures (Table 13). Out of the total selected households, around 34 percent of beneficiary and 37 percent of non-beneficiary households used to migrate for search of job to about 120-150 km away from their native places. The migrations was sometime in every season every year, depending upon the situation and mostly cited reasons for same were non availability of employment opportunity at their native places, due to drought kind of situation and non availability of drinking water. The duration of the days used to be away from native places for employment was on an average of six months in a year. Those who used to migrate had to work as agriculture labour or industry labour at other places. Also working in shops and in diamond industry was also alternative for some one.

However, after the construction of checkdam, the significant changes have been reported in reduction in migration of number of households. The decline in number of households migrated was significantly high in beneficiary households followed by non beneficiary households, i.e. after check dam only 3.5 percent of beneficiary and 6.0 percent of non beneficiary household experienced migration. The migration was mainly in rabi and summer season when there were no field operations and they migrated to mostly very nearby places. Also there was significant decline in number of persons migrated after checkdam. Thus, construction of checkdam has changed the economy of the selected villages by making available the employment opportunities to all classes of households.

Table 13: Nature and Stages of Migration

Sr. No.	Particulars	Migration-Beneficiary Households					
		M	S	SM	MED	L	T
(A)	Beneficiary Households:						
i)	Before Dam						
	No. of HH Migrated	24	21	10	5	7	67
	% to sample HH	49.0	41.2	27.0	16.7	21.2	33.5
	Duration of migration (days)	157	148	172	264	162	181
ii)	After Dam						
	No. of HH Migrated	4	0	2	1	0	7
	% to sample HH	8.2	0.0	5.4	3.3	0.0	3.5
	Duration of migration (days)	14	12	10	6	12	10.8
(B)	Non-Beneficiary Households:						
i)	Before Dam						
	No. of HH Migrated	6	4	3	4	0	17
	% to sample HH	37.5	33.3	30.0	66.7	0.0	34.0
	Duration of migration (days)	103	105	97	149	0	113.5
ii)	After Dam						
	No. of HH Migrated	2	0	1	0	0	3
	% to sample HH	12.5	0.0	10.0	0.0	0.0	6.0
	Duration of migration (days)	30	0	240	0	0	135

Source: Field Survey data.

The nature and stages of migration of landless agriculture labours are presented in Table 14. It can be seen from the table that before checkdam, all categories of households had to migrate to distance places every year, almost for some days in all seasons due to non availability of employment. After construction of check dam, the migration has declined drastically in all the categories except SC category labour and it became zero in all other categories. The number of days employment available for landless agriculture labour indicates that there is significant increase in number of days employment available in all seasons after the construction of checkdam. Also the wage rate has increased considerably which benefits the livelihood of these labours.

Table 14: Nature & Stages of Migration- Landless Agriculture Labour

Sr. No.	Particulars	Migration- Landless Agriculture Lab					
		Before Dam (2008-09)			After Dam (2012-13)		
		SC	SEBC	Gen	SC	SEBC	Gen
1	No. of HH Migrated	12	4	3	4	-	-
	% to sample HH	37.5	28.6	75.0	12.5	-	-
2	Duration of migration - days	88	66	113	80	-	-

Source: Field Survey data.



#### **4.2.13 Advantages of Check dam**

As seen earlier, besides beneficiary households, agriculture labours have also benefited directly, whereas non-beneficiary households also benefited indirectly due to check dam. It was observed that the beneficiary households agreed for the benefits of the checkdam such as store surface water for use (both during and after the monsoon), availability of water for drinking purposes, village pond got with full of water, increase in availability of water for irrigation (which ensures the increase in agriculture yield by multi cropping), increase in total crop production and thus income, it stopped ingress/entry of sea water, the level of soil salinity has decreased, the land quality has improved with dam water, availability of employment throughout the year has assured as well as wage rate has increased and thus need not to migrate during summer season, consistency in milk production due to availability of green fodder (due to water); value of land has increased, effective in restricting soil erosion; reduce poverty level due to wage/income increase; increased food self sufficiency, reinvestment of income into the farming business as safeguard for future, increased saving for costly future endeavors, improved provision for health care treatment due to increase in income, they could send children for higher education due to increase in income, improved the education opportunities; improved quality of life; secured against poverty/impoverishment and migration; land quality improved with dam water; check dam could also used for pisciculture, it has provided employment opportunities to local residents as well, check dam required no need modern and expensive technological developments; it is very easy and effective methods of water conservation; there was no question of acquisition of land; it has help in recharge of ground water in selected area. The most of the landless agriculture labour also mentioned that they are benefited from the construction of checkdam. Though the non-beneficiary households did not get direct benefits of water through checkdam, they were asked about the benefits of checkdam in their view in changing the economy of the villages. As like beneficiary households, non beneficiary households also opined the same, i.e. construction of checkdam has benefited the village as a whole by many ways.

#### **4.2.14 Disadvantages of Check dam**

Though there are the positive impacts of check dam, there are some negative aspects as well which must not be ignored. The selected households have mentioned their rank of agreement on the disadvantages of checkdam. In



selected villages, the closer of connecting road has created a lot of problem for the villages as now they have to travel long distance to reach to their field which has increased the cost of transfer of inputs and other services. In some selected villages, some grazing land has come under submergence, which causes inconvenience and has resulted in searching for other pastures further away. Also it has increased the unpaid workloads for women (from additional animal grazing responsibilities). During the high rainfall years, nearby fields got submerged and some houses in some villages also experienced of water seepage. Some of the farmers have mentioned that increase in labour cost has increased the cost of cultivation of crops. However, most of households have disagreed on the point of relocation or displacement of villages due to checkdam, because no relocation was done in this case.

### 4.3 Check dam Impact Ranking

The ranking of the impact of checkdam are presented Box 1. The views on development of village as a whole are presented in Box 2. It can be that as per their opinion, marginal and small farmers have benefited heavily and positive impact has been seen on all villages as well as all sections of the society.

Box 1: Ranking of Impact of the check dam

Impact Rating		
Highly Positive 5	Positive 4	No Impact 3
<ul style="list-style-type: none"> <li>• Change in cropping pattern in favour of high value crops</li> <li>• Increase in crop productivity</li> <li>• Increase in double cropping</li> <li>• Intra-Village water conflicts - decreased</li> <li>• More farm Employment</li> <li>• Choice in deciding quantum of water</li> <li>• Diversified Economic Activities :Dairying</li> <li>• Diversified Economic Activities : Other non agricultural activities</li> <li>• Stop ingress of sea water</li> </ul>	<ul style="list-style-type: none"> <li>• Timely water availability</li> <li>• Adequate water availability</li> <li>• Increase area under irrigation</li> <li>• Equitable distribution of water</li> <li>• Empowerment of Farmers</li> <li>• Equity achieved within the area of check dam</li> <li>• Beginning of a sense of ownership by farmers</li> <li>• Unification of diverse groups in the area</li> <li>• Freedom to raise resources</li> <li>• Resolution of disputes and dealing with offenses</li> <li>• Year- round availability of water for irrigation</li> <li>• Diversification of cropping pattern</li> </ul>	<ul style="list-style-type: none"> <li>• Choice in deciding irrigation timings</li> <li>• Active involvement of all classes</li> <li>• Inter-Village water related conflicts - increased</li> </ul>

#### 4.4 Problems faced by the Farmers

The problems faced by the farmers due to checkdam are presented in Box 3. The major problems, as viewed by stake holders are, i) need to travel long distance and incur more cost due to connecting road is submerged, ii) inadequate field channels, iii) high cost of diesel, iv) high cost of pipe and diesel (lift irrigation), v) lack of mechanism to control water use, vi) lack of quality planting materials, and vii) complaints from tail reach farmers.

Box 2: Contribution of Check dam (directly or indirectly) to the economic development of selected villages


Substantially positive (>50%)	Positive (10-40%)
Small/ marginal Farmers	Village as a whole, Women, Poor, Large/medium Farmers, Landless Labour/ wage earners, Livestock owners, Tribals, Upper Caste, Lower Caste, Scheduled castes, Head Reach Farmers, Tail Reach farmers, Youth

Box 3: Problems faced by the farmers due to the check dam

Major	Light/Occasional	None/No
<ul style="list-style-type: none"> <li>• Need to travel long distance and incur more cost due to connecting road is submerged</li> <li>• Inadequate field channels</li> <li>• High cost of diesel</li> <li>• High cost of pipe and diesel (lift irrig)</li> <li>• Lack of mechanism to control water use</li> <li>• Lack of quality planting materials</li> <li>• Complaints from tail reach farmer</li> </ul>	<ul style="list-style-type: none"> <li>• Road is submerged under check dam water</li> <li>• Lack of consensus in deciding cropping pattern</li> <li>• Nonpayment of water charges</li> <li>• Lack of investment credit with farmers</li> <li>• Problems in devising water distribution rules</li> </ul>	<ul style="list-style-type: none"> <li>• Agriculture land is submerged under check dam water</li> <li>• Lack of government support/funding</li> <li>• High cost of electricity</li> <li>• Poor quality of water</li> <li>• Lack of training to staff/members</li> <li>• Problems during the period when water is very scarce</li> <li>• Limited control over water flow</li> <li>• Lack of Leadership</li> <li>• Lack of freedom to determine water rates</li> </ul>

#### 4.5 Suggestions of Selected Households to Improve Use of Check dam

The stakeholders' assessment about the success of the check dam is that it is very successful and it has achieved the goals which were framed at the time of implementation of this project. In order to improve use of check dam



water and its impact on economy of selected villages, the selected households were asked to give their suggestions on same. Most of selected households have opined that height of dam should be increased to some extent as well as it should be deepen by removing the soil and other materials which would facilitate to store more water. Besides, they suggested for the cementing of distributory for irrigation water, proper distribution of water and availability of electricity for irrigation. In case of failure of electricity supply, availability of diesel for diesel pumpset should be ensured by the local authorities.

#### **4.6 Conclusions and Policy Implications**

Thus, above results and discussion clearly indicate a strong support to the benefits perceived from the construction of checkdam. The significant impact of availability of check dam water could be easily seen on the livelihood of beneficiary households through positive changes in land and livestock holdings, increase in crop yield and level of income, reduction in migration patter, etc. Though there are some negative effects which can be easily offset by the benefits of checkdam. Also with the benefits of checkdam, the problems can be taken care. Besides irrigation, water has many other uses such as drinking, bathing and washing. Also due to increase in production and productivity of crops, there was increase in income of farmer as well as agriculture labours which works as catalyst and as a multiplier effect in the development of economy of the selected villages. Thus, this kind of project should be taken up by the local authorities to help the farmers and labours to enhance their livelihood. The study brings out the following policy implications:

- The study is a strong indication of the benefits perceived from the construction of check dam. The positive benefits of check dam outweigh the few negative impacts. Therefore, small check dam should be built up for water conservation at the micro level and to help the farmers for support irrigation.
- Keeping in view the capacity of checkdam wall, the height of the checkdam need to be increased as well as check dam should be deepen by removing the soil and other material accumulated so as to increase water storage capacity.
- The farmers should be advised on judicious use of water (by adopting suitable cropping pattern/crop variety/salt and water stress tolerant crops) and use of water saving technologies.
- The digging of drain work should be completed so that remaining farmers can availed the benefits. Also cementing work of the drains



- should be carried out in order to facilitate the water movement.
- In order to ease the maintenance of dam and distribution of water, a regulatory body of villagers on the lines of participatory irrigation management such as water users association should be formed with support of state government.
- In case of submerging of road due to check dam water, government should construct the flyover bridge (cemented pipe) to facilitate the connectivity to field as well as nearby villages.
- Before starting the work of check dam at any place, a complete benchmark survey should be conducted through third party which would facilitate ultimately to know about exact impact of check dam on livelihood of villagers .
- Also related data (such as depth of water table, soil quality, water quality, area under irrigation, etc.) should be collected and need to be maintained by the irrigation department.
- The suitable tree plantation should be made on the border line of sea shore in order to reduce soil erosion, penetration of salty water in nearby farms.

## References

---

- Agarwal, A. and Narain, S. (Eds.) (1997), *Dying Wisdom: Rise, Fall and Potential of India's Traditional Water Harvesting Systems*, Fourth Edition, Centre for Science and Environment, New Delhi.
- Aini, A. (2007), "Water Conservation in Afghanistan," *Journal of Developments in Sustainable Agriculture*, Vol. 2. No.1, March, pp. 51-58.
- Arya, Swarn Lata and R. P. Yadav (2006), "Economic Viability of Rainwater Harvesting by Renovating Village Ponds in Small Agricultural Watershed of Johranpur (HP)," *Agricultural Economics Research Review*, Vol. 19, January-June, pp. 71-82.
- Ashraf M, M. A. Kahlowan, and A. Ashfaq (2007), "Impact of Small dams on Agriculture and Groundwater Development: A Case Study from Pakistan", *Agricultural Water Management*, Vol. 92, No.1-2, pp. 90-98.
- Balooni, K., A. H. Kalro, and A. G. Kamalamma (2008), "Community Initiatives in Building and Managing Temporary Check-Dams across Seasonal Stream for Water Harvesting in South India", *Agricultural Water Management*, Vol. 95, No. 12, December, pp. 1314 – 1322.

- CSQA (2003), California Stormwater BMP Handbook Construction-Check Dams SE-4, California Stormwater Quality Association, January.
- Engineer, R. (1990), “The Sardar Sarovar Controversy”, in Dhawan, R. D. (Ed.), *Big Dams: Claims, Counter Claims*, Commonwealth Publishers, New Delhi, pp. 155–174.
- Fromant, Emma (2009), “Impact Assessment of Check dams in the Jhabua region of Madhya Pradesh” (<http://www.asaindia.org>).
- Gale, I. N., D. M. J. Macdonald, R.C. Calow, M. Moench, H. Kulkarni, S. Mudrakartha and K. Palanisami (2006), “Managed Aquifer Recharge: An Assessment of its Role and Effectiveness in Watershed Management. Report No. CR/06/107N (BGS) (<http://nora.nerc.ac.uk/7453/1/CR06107N.pdf>).
- Hassanli, A.M. and A. E. Nameghi (2009), Evaluation of the Effect of Porous Check Dam Location On Fine Sediment Retention( A Case Study), *Earth and Environmental Science: Environmental Monitoring and Assessment*, Vol. 152, No. 1-4, pp. 319–326.
- Jagawat, Harnath (2005) ‘Transforming the Dry Lands: The Sadguru Story of Western India’, India Research Press, New Delhi.
- Kalamkar S. S., H. P. Tivedi, S. R. Bhaiya and D. J. Chauhan (2014) “Socio-Economic Impact of Check Dam constructed near Tarakpur Village of Khambat Taluka of Anand district”, *Agro-Economic Research Centre, Sardar Patel University, Vallabh Vidyanagar, Research Report No. 157, March*.
- Khanna, Sulbha (1996), “Check Dams- A Water Harvesting Technique For Sustainable Agricultural Development”, Aga Khan Rural Support Programme (India), Ahmedabad, AKRSP Publication, (<http://sulbhaskhanna.com/check%20dams1.pdf>).
- Khelifi, S., M. Ameer, N. Mtimet, N. Ghazouani, and N. Belhad (2010), “Impacts of Small Hill dams on Agricultural Development of Hilly land in the Jendouba region of Northwestern Tunisia”, *Agricultural Water Management*, Vol. 97, No. 1, pp. 50-56.
- Khosla A (1999), “Development Alternatives- Check Dam Evaluation Study”, available at [www.dainet.org/livelihoods/checkdams.htm](http://www.dainet.org/livelihoods/checkdams.htm).
- Kothari, A., 1998. *Environmental and Social Aspects of Large Dams in India: Problems of Planning, Implementation and Monitoring*. Paper presented at The First WCD Regional Consultation in Colombo, Sri Lanka, December 10–11.
- Lin, B.S.; C. H. Yeh and H. P. Lien (2008), “The experimental study for the

- allocation of ground-sills downstream of check dams”, International Journal of Sediment Research, Vol. 23, No. 1, March, pp. 28-43.
- MOWR (2002), National Water Policy, Ministry of Water Resources, (<http://wrmin.nic.in/policy/nwp2002.pdf>)
- Mudrakartha S (2003) Augmenting groundwater resources by artificial recharge at Aravalli Hills. Gujarat, India ([http://r4d.dfid.gov.uk/PDF/Outputs/Water/R8169-VIKSAT\\_INCEPTION\\_REPORT12\\_May\\_04.pdf](http://r4d.dfid.gov.uk/PDF/Outputs/Water/R8169-VIKSAT_INCEPTION_REPORT12_May_04.pdf)).
- Murty, J.V. S. (1994) ‘Watershed Management: Second Edition’, New Age International (P) Limited Publishers, New Delhi.
- Nair, G.K., 2002. Kerala: Focus on lift irrigation, big projects out. In: The Business Line, March 22.
- Neumann I, Barker J, and MacDonald D, Gale I (2004) Numerical approaches for approximating technical effectiveness of artificial recharge structures. Report Number. CR/04/265N, BGS. [www.iah.org/rechargedownloads/CR04265Numericalmodelling](http://www.iah.org/rechargedownloads/CR04265Numericalmodelling).
- Palanisami K, Raviraj A, and Thirumurthi S (2006) Artificial Recharge in Hard Rock Areas of Coimbatore District –A Case Study. International conference on Groundwater sustainable Development problems, perspectives and challenges (IGC-2006) <http://jnuenvis.nic.in/publication/IGC%202006%20Abstracts.pdf>.
- Paranjpye, V. (Ed.) (1990), High Dams on the Narmada: A Holistic Analysis of the River Valley Projects, Indian National Trust for Art and Cultural Heritage, Delhi.
- Pett , G.E. (1984), Impounded Rivers: Perspectives for Ecological Management, John Wiley and Sons, Chichester.
- PHDRDF (2011), “Socio-Economic Impact of Check Dams: A survey of Alwar and Sikar districts of Rajasthan, A Indicus Analytics study on Check Dams (Rain Water Harvesting Projects)”, undertaken by Rural Development Foundation (RDF) of PHD Chamber of Commerce and Industry ([http://www.phdcci.in/admin/admin\\_logged/banner\\_images/1315915539.pdf](http://www.phdcci.in/admin/admin_logged/banner_images/1315915539.pdf)), April 2011.
- Raghunath, A. (2003), “Kallada: Another Instance of Misuse of Public Money”, in The New Indian Express, June 7, Kozhikode.
- Rao, K.V. Seshagiri (2000) ‘Watersheds Comprehensive Development’, B. S. Publications. Hyderabad.
- Saranrom, Pichai (2011), “Making Portable Small Check Dams for Water Preservation from Rainy Season up to Dry Season in Eastern Region of



Thailand”, International Journal of Environmental Science and Development, Vol. 2, No. 5, October 2011.

## AERC Vallabh Vidyanagar- Research Studies/Reports Completed

Sr. No.	Report No.	Title of Report
1.	1.	A Study of Wheat Prices in the States of Gujarat and Rajasthan, by V. S. Vyas, 1963.
2.	2.	The Organization and Disintegration of a Collective Farming Society: A Case Study of a Gramdan Village, by K. M. Choudhary, July, 1966.
3.	3.	Economics of Well Irrigation in a Rajasthan Village, by K. R. Rakhral, published as an article in Artha Vikas, January 1967.
4.	4.	Agricultural Labour in Four Indian Villages, Ed. by V. S. Vyas, May, 1964.
5.	5.	Command Area of the Dantiwada Project (Socio-Economic Survey of Three Banaskantha Villages in Gujarat), by B. M. Desai, November, 1964.
6.	6.	Working of Fair Price Shops in Gujarat and Rajasthan (with Special Reference to Ahmedabad and Jaipur Cities), by R. M. Patel, March, 1965.
7.	7.	A Study of Pilot Co-operative Farming Societies in Gujarat and Rajasthan by M. D. Desai and K. S. Karanth, December, 1964.
8.	8.	Factors Affecting Marketable Surplus and Marketed Supplies (A Study in Two Regions of Gujarat and Rajasthan) by V. S. Vyas & M. H. Maharaja, January, 1966.
9.	9.	Factors Affecting Acceptance of Improved Agricultural Practices (A Study in an I. A. D. P. District in Rajasthan), by K. M. Choudhary, November, 1965.
10.	10.	Economics of Cotton Cultivation (A Study in a selected region of Sabarkantha District of Gujarat), by M. H. Maharaja, May, 1966.
11.	11	Economic Survey of Borsad Taluka (Gujarat State) with Special Reference to the Impact of Community Development Programme by M. L. Bhat, December, 1966.
12.	12.	An Evaluation of Some Aspects of Hybrid Maize Programme in Dahod Taluka (Panchmahal District, Gujarat), by B. M. Desai, January, 1967.
13.	13.	An Assessment of Co-operative Farming Societies in Gujarat and Rajasthan (A few Case Studies), by K. M. Choudhary, M. T. Bapat, N. R. Shah, D. P. Gupta, K. R. Pichholiya and S. B. Saxena, August, 1967.
14.	14.	An Enquiry into the Implementation of Farm Plans in Bardoli Taluka (A Study in an I. A. D. P. District in Gujarat) by V. S. Dharap and M. H. Maharaja, August, 1967.
15.	15.	New Strategy of Agricultural Development in Operation (A Case Study of the Kaira District in Gujarat), by B. M. Desai and M. D. Desai, July, 1968.
16.	16.	Conditions of Stability and Growth in Arid Agriculture, by N. S. Jodha and V. S. Vyas, December, 1968.
17.	17.	Significance of the New Strategy of Agricultural Development for Small Farmers: A Cross-sectional Study of Two Areas, by V. S. Vyas, D. S. Tyagi and V. N. Misra, January, 1969.
18.	18.	A Study of the Hybrid Bajra Programme in the Kaira District, Gujarat (Summer 1967-68), by N. R. Shah, June, 1969.



19.	19.	A Study of the Hybrid Bajra Programme in the Ahmedabad District, Gujarat (Kharif, 1968-69), by V.S. Dharap, June, 1969.
20.	20.	Some Aspects of Long Term Agricultural Finance - A Study of Two Areas in Gujarat, by N.S. Jodha & M.L. Bhat, July, 1969.
21.	21.	A Study of High Yielding Varieties Programme in the Kota District, Rajasthan (Rabi 1968-69), by D.S. Tyagi and V.N. Misra, October, 1969.
22.	22.	Prospects and Problems of Dairy Development in a Desert Region (A Study in the Bikaner District of Rajasthan) by N.S. Jodha and K.M. Choudhary, March, 1970.
23.	22a	Economics of Dairy Farming in Mehsana District of Gujarat State by Dr. V.S. Vyas and K.M. Choudhary, 1971.
24.	23.	An Enquiry into the Working of Cooperative Credit Institutions (A Study in Bhilwara District in Rajasthan), by M.L. Bhat & N.R. Shah, July, 1971.
25.	24.	Economic Profile of Marginal Farmers and Labourers (A Study in the Borsad Taluka of Gujarat) by R.M. Patel, May, 1972.
26.	25.	Green Revolution and Problems of Marketing (A Study of Production and Marketing of Bajra in three Districts of Gujarat), by S. L. Bapna, July, 1972.
27.	26.	Some Aspects of Co-operative Short Term Agricultural Finance (A Study in Three Areas in Gujarat), by N.S. Jodha, March, 1973.
28.	27.	Integrated Dryland Agricultural Development Programme: A Case Study of the Rajkot Taluka in Gujarat (Rabi 1971-72), by H.F. Patel, April, 1973.
29.	28.	Economic and Social Implications of Green Revolution (A Case Study of the Kota District), by S.L. Bapna, May, 1973.
30.	29.	Drought Prone Area Programme : A Case Study of the Banaskantha District in Gujarat (Rabi 1971-72), by R.D. Sevak, May, 1973.
31.	30.	Saving and Investment in an Agriculturally Prosperous Area (A Study of Farmers in Surat District), 1969-70, by M.D. Desai, 1973. (Supplement) Employment, Income and Levels of Living of Agricultural Labourers (A Study in the Surat District, Gujarat), 1969-70, M.D. Desai, 1974.
32.	31.	Consumption Pattern in Rural Gujarat: A Study of Four Villages in Anand Taluka, by V.C. Patel, August, 1973.
33.	32.	Drought Prone Area Programme: A Study of the Banaskantha District in Gujarat (Kharif 1972-73) by K.M. Choudhary and R. D. Sevak, October, 1973.
34.	33.	Saving and Investment in an Agriculturally Prosperous Area (A Study in the Kota District, Rajasthan), 1970-71, by S.L. Bapna and N.R. Shah, December, 1973.
35.	34.	Integrated Dryland Agricultural Development Programme: A Case Study of Rajkot Taluka in Gujarat, 1972-73, by R.M. Patel and H.F. Patel, May, 1974.
36.	35.	Saving and Investment in an Agriculturally Prosperous Area (A Case Study of the Surat District in Gujarat), 1970-71, by M.D. Desai, June, 1974.
37.	36.	Saving and Investment in an Agriculturally Prosperous Area (A Study in the Kota District, Rajasthan), 1971-72, by S.L. Bapna, October, 1974.

38.	37.	Employment Pattern in Rural Gujarat (A Study of Four Villages in the Anand Taluka), 1970-71, by V.C. Patel, R. Indu and Vilas P. Patel, January, 1975.
39.	38.	Drought Prone Area Programme : A Case Study of the Banaskantha District in Gujarat (Rabi & Summer 1972-73), by R.D. Sevak, March, 1975.
40.	39.	Employment Situation in Dry Agriculture: A Study in an IDAD Project Area (Rajkot Taluka, Gujarat), by H.F. Patel, April, 1975.
41.	40.	Saving and Investment in an Agriculturally Prosperous Area: A Case Study of the Surat District, 1971-72, by M. D. Desai, April, 1975.
42.	41.	Saving and Investment in an Agriculturally Prosperous Area (A Case Study in the Kota District, Rajasthan), 1972-73, by S.L. Bapna, May, 1975.
43.	42.	Levels of Agricultural Development in Tehsils of Rajasthan, by M. T. Pathak and M.D. Desai, August, 1975.
44.	42a	Development of Agricultural in the Backward Regions of Gujarat: Facts and Issues, by Mahesh T. Pathak, Mahendra D. Desai and A.S. Charan, January,
45.	42b	A Study of Storage Space for Foodgrains (A Micro Study of Cambay Taluka, Gujarat), by S. L. Bapna, February, 1975.
46.	43.	Saving and Investment in an Agriculturally Prosperous Area: A Study in the Kota District, Rajasthan, 1970-71, 1972-73, General Report, by S.L. Bapna and Case Studies, by H.M. Verma, Oct, 1975.
47.	44.	A Study of Impact of Famine and Relief Measures in Gujarat and Rajasthan (with Special Reference to the Banaskantha & Barmer Districts), by K. M. Choudhary & M.T. Bapat, December, 1975.
48.	45.	An Economic Profile of the Kadana Irrigation Project and its Command Area, by D. M. Brahmbhatt, March, 1976.
49.	46.	Factors Affecting Milk Supply to Co-operative Dairies in Gujarat: A Study of Amul and Dudhsagar Dairies, by V.C. Patel & M.D. Desai, April, 1976.
50.	47.	Saving and Investment in an Agriculturally Prosperous Area (A Study in the Surat District, Gujarat) Combined Report 1969-70/1971-72, General Report by M.D. Desai and Case Studies, by A.D. Chauhan, July, 1976.
51.	48.	Transforming Tribal Agriculture (An Evaluation of the Leap Forward Project of the Gujarat State Fertilizers Company Ltd., by D.M. Brahmbhatt & M. T. Bapat, September, 1976.
52.	49.	Some Aspects of Agricultural Development in Gujarat (1949-50 -1974-75) (A Review & Final Report), by Mahesh Pathak, M.D. Desai and H.F. Patel, April, 1977.
53	50.	An Evaluation of Drought Prone Area Programme (A Study of the Jodhpur and Jaisalmer Districts in Rajasthan), by R.D. Sevak and S.D. Purohit, Case Study by V.M. Patel, May, 1977.

54.	51.	4 P Plan-Crop Insurance Scheme for Hybrid-4 Cotton in Gujarat (An Evaluation of the Promotional Project "Package of Practices for Productivity and Prosperity" of the GSFC Ltd.), by K.M. Choudhary, August, 1977.
55.	52.	Working of Farmers' Service Societies in Gujarat (Two Case Studies of Tribal Areas in Gujarat) by D.M. Brahmbhatt & M. T. Bapat, January, 1978.
56.	53.	Economic Relationship between Crop Farming and Dairying in a Developing Area: A PL-480 Micro-Level Study of South Gujarat, by A. S. Patel and N.S. Jodha, January, 1979.
57.	54.	Block Level Plan, Balasinor Taluka (Kheda District, Gujarat), by Mahesh Pathak and N.R. Shah, October, 1979.
58.	55.	Performance of Hybrid Bajri in Gujarat, 1966-67 to 1976-77, by R.D. Sevak and D.M. Brahmbhatt, March, 1980.
59.	56.	Block Level Plan, Thasra Taluka (Kheda District, Gujarat), by Mahesh Pathak and Navin R. Shah, September, 1981.
60.	57.	Evaluation of Intensive Cotton District Programme and Aerial Spraying Scheme in the Baroda District, Gujarat, by K.M. Choudhary, June, 1981.
61.	58.	Socio-Economic Profile, Narmada Command Area (Ahmedabad District), 1981), First Phase Report – June, 1982.
62.	59.	Inter-District Variations in Agricultural Development in Gujarat (1949-50 to 1978-79), by Mahesh Pathak and H.F. Patel, August, 1982.
63.	60.	Soil Testing Service in Rajasthan, by R.D. Sevak, September, 1982.
64.	61.	Working of Small Farmers' Development Agency: Bharuch District, Gujarat, by M.T. Bapat, March, 1983.
65.	62.	Working of Small Farmers' Development Agency: Udaipur District, Rajasthan, by S. D. Purohit, June, 1983.
66.	63.	Production and Marketing of Mangoes in Gujarat, by D. M. Brahmbhatt, January, 1984.
67.	64.	Socio-Economic Profile: Narmada Command Area (Ahmedabad District Second Phase Report), September, 1985, 2nd phase report, Tables March, 1985 (Published Report no. 58).
68.	65.	Economics of Dairy Enterprise in Gujarat (Sabarkantha District, Gujarat), by R.M. Patel, K.M. Choudhary, R.D. Sevak and V.D. Shah, September, 1985.
69.	66.	Social Forestry Programme in Rajasthan (with Special Reference to Dungarpur and Bharatpur Districts, Rajasthan), by D.M. Brahmbhatt, June, 1985.
70.	67.	Economics of Tubewell Irrigation in Gujarat, by Mahesh Pathak, A. S. Patel and H. F. Patel May, 1985.
71.	68.	Cost of Milk Production in Gujarat (A Case Study of Mehsana District), by R. D. Sevak, June, 1986.

72.	69.	Groundnut Development Programme in Gujarat, by Navin R. Shah, July, 1986.
73.	70.	Repayment of Minor Irrigation Loan of Land Development Bank in Gujarat (A Case Study of Dhanera Taluka of Banaskantha District), by V.D. Shah, September, 1986.
74.	71.	Cost of Milk Production in Rajasthan (A Case Study of Bhilwara District), by S.D. Purohit, October, 1986.
75.	72.	Socio-Economic Profile of Action Research Programme Area in Mahi Kadana Irrigation Project, by D. M. Brahmbhatt, September, 1987.
76.	73.	Intensive Pulse Development Programme in Gujarat (Case Studies of Panchmahals and Bharuch Districts), by Madhukar Bapat, July, 1987.
77.	74.	Price Support Operations for Mustard Seed by NAFED in Rajasthan by Rajnarayan Indu, August, 1987.
78.	75.	National Rural Employment Programme in Gujarat (A Case Study of Kheda District), by D. M. Brahmbhatt, V. M. Patel and V. J. Dave, November, 1987.
79.	76.	Evaluation of Catchment Area Development Programme (A Case Study of Dantiwada Catchment in Gujarat), by Navin R. Shah, November, 1987.
80.	77.	Some Reflections on Integrated Dry Land Agricultural Development (A Case Study of Rajkot Taluka, Gujarat, by R.M. Patel, February, 1988.
81.	78.	Evaluation of Public Distribution System in Rajasthan by K. M Choudhary, May, 1988.
82.	79.	Socio-Economic Profile of Action Research Programme Area in Mahi-Kadana Irrigation Project by D.M. Brahmbhatt, May, 1988.
83.	80.	Fertilizer Consumption in Gujarat, by V.D. Shah, March, 1989.
84.	81.	An Evaluation Study of Bajra Minikit Programme (A Case Study of Jaipur District in Rajasthan), by S.D. Purohit, March, 1989.
85.	82.	Terms of Trade for Agriculture (A Case Study of Gujarat), by M. L. Jhala, April, 1989.
86.	83.	Recent Trends in the Cost of Cultivation in Gujarat, by A. S. Patel and H.F. Patel, September, 1989.
87.	84.	Prospects of Increasing Oilseed and Pulse Production in Gujarat, by N.R. Shah, January, 1990.
88.	85.	A Profile of Employment in Rajasthan-Case Studies of Barmer and Jaisalmer Districts, by D.M. Brahmbhatt, V.M. Patel, V.J. Dave & H.M. Verma, November, 1990.
89.	86.	Action Research Programme - An Interim Evaluation (A Case Study of Mahi-Kadana Irrigation Project), by A. S. Patel & D. M. Brahmbhatt, October, 1991.
90.	87.	Transportation of Agricultural Products in Gujarat, by H. G. Patel, February, 1993.

91.	88.	Some Aspects of Land Use Planning in Gujarat, by Rajeshree A. Dutta, March, 1993.
92.	89.	Impact of Fertilizer Price Hike on Gujarat Agriculture, by Mahesh Pathak, V. D. Shah and M. L. Jhala, June, 1993.
93.	90.	Evaluation of Watershed Development Programme (A Study of Two Districts in Rajasthan), by S. D. Purohit, March, 1994.
94.	91.	Inter-District Variations in Agricultural Development in Rajasthan-1956-57 to 1989-90, by D. Bagchi & H. M. Verma, March, 1994.
95.	92.	Economic Viability of Small and Marginal Farms in Rainfed Agriculture (A Case Study of Bhavnagar District in Gujarat), by V. J. Dave, June, 1994.
96.	93.	Economic Viability of Small and Marginal Farms in Irrigated Agriculture (A Study of Panchmahals District in Gujarat), by V.G. Patel, July, 1994.
97.	94.	Inter-District Variations in Agricultural Development in Gujarat: 1949-50 - 1991-92, by Mahesh Pathak, H.F. Patel and Rajeshree A. Dutta, October, 1994.
98.	95.	Recovery Performance of Institutional Farm Credit in Rajasthan (An In-depth Study in Bharatpur District) by D.M. Brahmbhatt and V.J. Dave, September 1995.
99.	96.	Emerging Problems of Agricultural Marketing (A Case Study of Tomato in Gujarat), by V. M. Patel, November, 1995.
100.	96/1	Impact of Subsidies on Agricultural Development in Gujarat, by R. A. Dutta, 1995.
101.	97.	Evaluation of Engineering Structures under Soil Conservation Scheme (A Case Study of Chambal RVP and Sahibi FPR in Rajasthan), by S.D. Purohit and H.M. Verma, November, 1995.
102.	98.	Emerging Problems of Agricultural Marketing (A Case Study of Mustard in Gujarat), by N.R. Shah, December, 1995.
103.	99.	Decentralized Planning in Agriculture and Rural Development (A Case Study of Bharuch district in Gujarat), by D.M. Brahmbhatt, May, 1996.
104.	100.	Emerging Problems of Agricultural Marketing (A Case Study of Banana in Gujarat), by V.M. Patel, Sept, 1996.
105.	101.	Evaluation of Engineering Structures under Soil Conservation Scheme (A consolidated report of AERC Studies), by S.D. Purohit, August, 1996.
106.	102.	Impact of National Watershed Development Project for Rainfed Areas (NWDPPRA) in Gujarat, by V. D. Shah and V.G. Patel, December, 1996.
107.	103.	Analysis of Trends in Operational Holdings in Gujarat, by Rajeshree A. Dutta, March, 1997.
108.	104.	Analysis of Trends in Operational Holdings in Rajasthan, by Rajeshree A. Dutta and H.M. Verma, March, 1997.

109.	105.	Evaluation of Fish Farmers' Development Agencies in Gujarat (A Study in Valsad, Panchmahals and Rajkot districts), by V.J. Dave, September, 1997.
110.	106.	Economics of Export oriented Horticulture Crop Chiku (Sapota) in Gujarat (A Case Study in Valsad district), by V. J. Dave, July, 1998.
111.	107.	Oilseeds Development Perspective under Liberalised Economy, by Rajeshree A. Dutta and H.M. Verma, July, 1998.
112.	108.	Production and Utilisation Pattern of Milk at the Rural Producer's Level in Gujarat, by V.D. Shah, Oct, 1998.
113.	109.	Economics of Pulses Production and Identification of Constraints in Raising their Production in Rajasthan, by H. M. Verma, October, 1999.
114.	110.	Economics of Pulses Production and Identification of Constraints in Raising their Production in Gujarat, by V. G. Patel, February, 2000.
115.	111.	Role of Co-operative Credit in the Development of Different Size Group of Farmers in Gujarat (A Case Study in Rajkot district), by V.J. Dave, February, 2000.
116.	112.	Impact of National Watershed Development Project for Rainfed Areas (NWDPR) (A Rapid Assessment), by V.D. Shah, December, 2000.
117.	113.	Evaluation of Management of Seed Supply in Oilseeds and Pulses in Gujarat, by Rajeshree A. Dutta, H.M. Verma and C.F. Patel, December, 2000.
118.	114.	Evaluation of Management of Seed Supply in Oilseeds and Pulses in Rajasthan, by V.D. Shah, April, 2001.
119.	115.	Likely Impact of Liberalised Imports and Low Tariff on Edible Oil Sector in Rajasthan, by Rajeshree A. Dutta and H.M. Verma, July, 2001.
120.	116.	Evaluation of Fish Farmers' Development Agencies (FFDA) in Rajasthan, by Dilip Bagchi and H. M. Verma, August, 2001.
121.	117.	Assessing the Existing Training and Testing Facilities of Farm Machinery in Gujarat, by Mahesh Pathak, H.F. Patel and V.D. Shah, October, 2001.
122.	118.	Flow of Credit to Small and Marginal Farmers in Gujarat, by Shri V. J. Dave and Shri Dilip Chauhan, January, 2002.
123.	119.	Role of Co-operative Credit in the Development of Different Size Groups of Farmers (A Consolidated Study), by V. J. Dave, June, 2002.
124.	120.	Assessing the Existing Training and Testing Facilities of Farm Machinery in Rajasthan, by H. M. Verma, April, 2002.
125.	121.	Evaluation of National Oilseeds and Vegetable Oils Development (NOVOD) Board sponsored Development Programmes for Promotion of Oilseed crops in Non-traditional Areas: Consolidated Report, by Rajeshree. A. Dutta, January, 2003.
126.	122.	Review of State Agriculture Policy in Rajasthan (Part I and II), by Dilip Bagchi, February, 2004.
127.	123.	Impact of Minimum Support Prices on Agriculture Economy of Gujarat, by V. D. Shah and H. F. Patel, August, 2003.

128.	124.	Rural Non-Farm Employment in Gujarat, by Rajeshree A. Dutta and S. R. Bhaiya, March, 2004.
129.	125.	Co-operative Marketing Societies: Reasons for Success and Failures in Gujarat, by V. J. Dave, June, 2004.
130.	126.	Building Up of an Efficient Marketing System to Obviate the Need for Large-scale State Intervention in Gujarat, by P.K. Singh, May, 2004.
131.	127.	Agro-Economic Research for Agriculture Policy (Gujarat and Rajasthan Experience: 1980-2004), by Mahesh Pathak and V. D. Shah, July, 2004.
132.	128.	Review of State Agriculture Policy in Gujarat (Part I and II), by Arun S. Patel, July, 2004.
133.	129.	Role of Water Markets in Groundwater Management in Rajasthan, by H. M. Verma and S. R. Bhaiya, October, 2004.
134.	130.	Co-operative Marketing Societies in the States– Reasons for Success and Failure (A Consolidated Report), by V. J. Dave, September, 2004.
135.	131.	Participatory Irrigation Management in Gujarat (A Study in Mehsana, Anand Bhavnagar Districts), by H. F. Patel and V. J. Dave, September, 2006.
136.	132.	Viable Entrepreneurial Trades of Women in Agriculture: Rajasthan, by Rajeshree A. Dutta, December, 2006.
137.	133.	Study for Estimation of Seed, Feed and Wastage Ratios for Major Food grains in Rajasthan, by Rajeshree A. Dutta, February, 2007.
138.	134.	Returns to Bt. Cotton vis-à-vis Traditional Cotton Varieties in Gujarat State, by V. D. Shah, May, 2007.
139.	135.	State Budgetary Resources and Agricultural Development in Rajasthan, by Rajeshree A. Dutta, September, 2009.
140.	136.	State Budgetary Resources and Agricultural Development in Gujarat, by Rajeshree A. Dutta, December, 2009.
141.	137.	Impact Evaluation of Revised National Watershed Development Project for Rainfed Areas (NWDPR) during 10th Plan in Rajasthan, by V D Shah, January, 2010
142.	138.	Evaluation of Comprehensive District Agriculture Plans (C-DAPs) of 3 Districts of Gujarat, by Mahesh Pathak and V. D. Shah, January, 2011.
143.	139.	Impact of NREGA on Wage Rates, Food Security and Rural Urban Migration in Rajasthan, by Mrutyunjay Swain and Shreekant Sharma, April, 2011.
144.	140.	Possibilities and Constraints for Increasing the Production of Pulses in Rajasthan and Impact of National Food Security Mission on Pulses, by Rajeshree A. Dutta and K. M. Kapadia, May, 2011.
145.	141.	Impact of NREGA on Wage Rates, Food Security and Rural Urban Migration in Gujarat, by V D Shah and Manish Makwana, May, 2011.

146.	142.	Impact of National Horticulture Mission (NHM) Scheme in Rajasthan, by M. Swain, R. H. Patel and Manish Kant Ojha, September, 2011.
147.	143.	Evaluation of Comprehensive District Agriculture Plans (C-DAPs) of 3 districts of Rajasthan, by Rajeshree A. Dutta and Dilip Bagchi, November 2011.
148.	144.	Economics of Fodder Cultivation and its Processing and Marketing in Gujarat, by V. D. Shah, Manish Makwana and Shreekant Sharma, November, 2011.
149.	145.	State of Rajasthan Agriculture 2011-12, December 2012, by M.N. Swain, S.S. Kalamkar and Manish Kant Ojha.
150.	146.	State of Gujarat Agriculture 2011-12, December 2012, by M.N. Swain, S.S. Kalamkar and Kalpana Kapadia.
151.	147.	Problems and Prospects of Oilseeds Production in Rajasthan: Special reference to Rapeseed and Mustard, February, 2013, by M.N. Swain
152.	148.	Problems and Prospects of Oilseeds Production in Gujarat: Special reference to Groundnut, April 2013, by M.N. Swain.
153.	149.	Evaluation of Price Support and Market Intervention Scheme in Rajasthan, April 2013, S.S. Kalamkar, M. R. Ojha and T. B. Parihar.
154.	150.	Marketed and Marketable Surplus of Major Foodgrains in Rajasthan, April, 2013, V. D. Shah and Manish Makawana.
155.	151.	Assessment of Pre and Post Harvest Losses in Tur Crop in Gujarat, May 2013, by Rajeshree A. Dutta, Manish Makawana and Himanshu Parmar.
156.	152.	Assessment of Pre and Post Harvest Losses in Soybean Crop in Rajasthan, May, 2013, by Rajeshree A. Dutta, Manish Makawana and Himanshu Parmar.
157.	153.	Agro-Economic Research for Agriculture Policy: Gujarat and Rajasthan Experience (1961-2013), November 2014, by Mahesh Pathak, S.S. Kalamkar and V. D. Shah
158.	154.	Adoption of recommended doses of fertilizer on soil test basis by farmers in Gujarat, December 2014, by Mrutunjay Swain, S. S. Kalamkar and Kalpana Kapadia.
159.	155.	Impact of National Food Security Mission (NFSM) on Input use, Production, Productivity and Income in Gujarat, March 2015, R.A. Dutta, S.S. Kalamkar and M. R. Ojha.
160.	156.	Relationship between wholesale prices, retail prices, and details of contributing factors for the price difference of Onion in Gujarat, March 2015, by S. S. Kalamkar and M. Makwana.
161.	157.	Socio-Economic Impact of Check Dam constructed near Tarakpur Village of Khambat Taluka of Anand district, by S.S. Kalamkar, H.P. Trivedi, S.R. Bhaiya and D. J. Chauhan, July 2014



162.	158.	Estimation of Changes in Income and Cost of Production owing to Changes in Inputs and Hybrid Seeds for major Crops of Gujarat, by S.S. Kalamkar, M.N. Swain and S.R. Bhaiya, December 2014
163.	159.	Socio-Economic Impact Analysis of Introduction of Renewable Energy Technologies in Five Tribal Villages of Gujarat, by S.S. Kalamkar, M.N. Swain and Samir Vohara, March 2015
164.	160.	"Impact Evaluation of Rashtriya Krishi Vikas Yojana (RKVY) in Gujarat", March 2015, by S.S. Kalamkar, S.R. Bhaiya and M. Swain.
165	161.	"Impact Evaluation of Rashtriya Krishi Vikas Yojana (RKVY) in Rajasthan@, March 2015 by S.S. Kalamkar, and Mrutunjay Swain.
166	162	Soil Health Card Programme in Gujarat: Implementation, Impacts and Impediments (CIPT), January 2016, by Mrutunjay Swain and S.S. Kalamkar
167	163	Evaluation and Assessment of Economic Losses on account of Inadequate Post-harvest Infrastructure Facilities for Fisheries Sector in Gujarat State, March 2016, by H. Sharma, M. Swain and S. S. Kalamkar

### Studies for Planning Commission, GOI

Sr. No.	Report No.	Title of Report
01	ACZ13-1/1988	Profile Report-Agro-Climatic Zone No. 13, Gujarat Plains and Hills Region, by Dr. Mahesh Pathak, Dr. A.S. Patel and Dr. H. F. Patel, 1988.
02	ACZ13-2/1988	Strategy for Agricultural Development in Gujarat during the Eighth Plan-Agro-Climatic Zone No. 13, by Dr. Mahesh Pathak, 1988.
03	ACZ14-1/1988	Profile Report-Agro-Climatic Zone No. 14, Western Dry Region, Rajasthan, by Dr. Mahesh Pathak and Dr. Dilip Bagchi, 1988.
04	ACZ14-2/1988	Strategy for Agricultural Development in Gujarat during the Eighth Plan-Agro-Climatic Zone No. 14, Western Dry Region, Rajasthan, by Dr. Mahesh Pathak, 1988.
05	ACZ13-1/1988	"Impact Evaluation of Rashtriya Krishi Vikas Yojana (RKVY)-Gujarat and Rajasthan [worked as partner Institution for data collection and feeding work for the states of Gujarat (8 districts) and Rajasthan (7 districts), March 2014 by S.S. Kalamkar.

## Working Papers published

Sr. No.	WP No.	Paper Title	Author/s	Month of publication & pages
01	2013/01	“Price Support and Market Intervention Scheme in Rajasthan”	S.S. Kalamkar, M. R. Ojha and T. B. Parihar	October 2013, pp. 1-40.
02	2014/01	“Problems and Prospects of Oilseeds Production in Gujarat”	Mrutyunjay Swain	May 2014, pp. 1-52
03	2015/01	“Adoption of recommended doses of fertilizer on soil test basis by farmers in Gujarat”,	Mrutunjay Swain, S. S. Kalamkar and Kalpana Kapadia	May 2015, pp. 1-36.
04	2015/02	“Impact of National Food Security Mission (NFSM) on Input use, Production, Productivity and Income in Gujarat”	R.A. Dutta, S. S. Kalamkar & M. R. Ojha	June 2015, pp.1-42.
05	2015/03	“Relationship between Wholesale Prices, Retail Prices, and Details of Contributing factors for the Price difference of Onion in Gujarat”	S.S. Kalamkar and M. Makwana	Sept. 2015, pp. 1-52.
06	2016/01	Marketed and Marketable Surplus of Major Food grains in Rajasthan	V. D. Shah and Manish Makwana	July 2016, pp. 1-38.
07	2016/02	Socio-Economic Impact of Tarakpur Check Dam in Khambhat Area of Gujarat	S. S. Kalamkar, H. P. Trivedi, S. R. Bhaiya and D. J. Chauhan	October 2016 pp. 1-38



aerc vallabh vidyanagar working paper

aerc vallabh vidyanagar working paper

aerc vallabh vidyanagar working paper

aerc vallabh vidyanagar working paper

aerc vallabh vidyanagar working paper

aerc vallabh vidyanagar working paper

aerc vallabh vidyanagar working paper

aerc vallabh vidyanagar working paper

aerc vallabh vidyanagar working paper

aerc vallabh vidyanagar working paper

aerc vallabh vidyanagar working paper

aerc vallabh vidyanagar working paper

aerc vallabh vidyanagar working paper

aerc vallabh vidyanagar working paper

aerc vallabh vidyanagar working paper

aerc vallabh vidyanagar working paper



## **Agro-Economic Research Centre**

For the States of Gujarat and Rajasthan  
(Ministry of Agriculture & Farmers Welfare, Govt. of India)

H.M. Patel Institute of Rural Development

Opp. Nanadalaya Temple, Post Box No. 24

**Sardar Patel University**

**Vallabh Vidyanagar 388120, Dist. Anand, Gujarat**

Ph. No. +91-2692-230106, 230799; Fax- +91-2692-233106

Email: director.aerc@gmail.com; director.aercgujarat@gmail.com

Websites: www.aercspu.ac.in; www.spuvvn.edu