

Rainwater harvesting and its judicious use is the key for enhancing irrigated area, cropping intensity, land productivity and farm profitability in rainfed areas. In rigid water harvesting structures like cement concrete check dam, gabion etc., higher peak flows damages the structure besides reducing its storage capacity due to high siltation. Further in climate change scenario, we may experience frequent extreme weather events of high intensity rainfall, cyclone, flood, drought, and long dry spells etc. causing crop loss and land degradation. In order to control runoff, conserve rainwater, reduce land degradation and utilize the stored water for irrigation, ICAR flexi-check dam (rubber dam) is an alternative option for rain water harvesting in watershed development and management.

ICAR Flexi-check Dam (Rubber Dam)

ICAR flexible check dam commonly known as **rubber dam** is an inflatable structure build across a stream used for water conservation, flood control and regulating flow of water in the stream. When it is inflated, it serves as a check dam/weir and when it is deflated it functions as a flood mitigation device and sediment flushing.

The head or height of rubber dam is variable. This variable head also regulates the depth of flow in the irrigation diversion channel present in the upstream side of the check dam or in irrigation canals and distributaries. This can also be used in coastal creeks, estuaries, streams and channels to restrict the inflow of sea water into land mass. During high tide it can also prevent the high tides to enter into the fresh water system.

As an innovative hydraulic structure, the rubber dam mainly consists of the following parts: (i) a concrete foundation with head wall extension, side wall and wing wall of a normal check dam; (ii) the head wall replaced by rubberized fabric dam body; (iii) anchoring system (anchoring of rubber sheet with bottom and side of the check dam); (iv) Inflation deflation system (an inlet/out let piping system for inflation and deflation by water); and (v) a pump for filling water for inflation.

The span or length of the rubber dam can vary from 1 m to 10 m (depending upon the width of the stream). For wider streams also, there can be several spans.



Rubber dam at Konkan region, Dapoli, Maharashtra



Rubber dam at Chandesar-2, Khorda, Odisha

Advantages of Rubber Dam

- Traditional check dams get silted up due to continuous inflow of sediment from upstream side thus reducing the storage capacity. Rubber dam can be occasionally deflated during flood to flush out the deposited sediment in the upstream side.
- During dry period/ lean season, the head wall can be easily inflated to store more water.
- Due to flexibility of the head wall, during extreme events of high intensity rainfall and extreme flood situation, the structure can be easily deflated. This prevents damage to the structure, breaching of stream bank/ levees, and erosion of stream bed.
- Earth quake, land slide cannot damage the head wall as it is made of rubber and repair to the side and wing walls can be easily done without dismantling the structure.
- There will be no conflict of interest between the upstream and downstream farmers and other beneficiaries as desirable amount of water can be easily delivered to downstream side by storing the required quantity in the upstream side and thereby maintaining environmental flow.

Fixed and Variable Cost

The cost of rubber dam along with its RCC base structure varies from ₹1 lakh to 10 lakh in small watershed streams for 3 to 15 m width. The cost of rubber dam is at par with the traditional check dam having a life span of 20 years. Since the head wall is semicircular in shape and hydraulic jump occurs very close to the structure, a long apron is not required, thus reducing the cost of the base structure. The head wall is replaced by a composite rubber sheet. The cost of 8 mm thick rubber composite sheet is around Rs. 3000/m² (2016 price). However the cost will reduce when produced on commercial scale in large quantity. The operating cost is variable and is required to deflate during high flood, inflate during dry period or any other emergency condition and then pumping cost for inflation. On an average 4 to 5 times inflation/ deflation is required which will cost around Rs.1000 per year.

Water Storage at different Heights of Rubber Dam and Bed Slope

List of ICAR-Flexi Check Dam (Rubber Dam) installed in India under NAIP & Agri-CRP on Water is provided in the following Table 1. The water storage volume (m³) with respect to



Table 1. List of ICAR-Flexi Check Dam (Rubber Dam) installed in India under NAIP & Agri-CRP on Water

Sl.No	Name of the Indian State	Name of the district	No of rubber dams
1.	Odisha	Khordha	5
		Koraput	3
		Nabarangpur	1
		Baleswar	3
		Dhenkanal	1
2.	Maharashtra	Ratnagiri	3
		Pune	3
3.	Gujarat	Navsari	4
4.	Uttarakhand	Dehradun	3
		Tehri Garhwal	1
5.	Meghalaya	Ri-bhoi	1
6.	Himachal Pradesh	Kangra	2
7.	Tamil Nadu	Nilgiris	1
8.	West Bengal*	West Medinipur	2

*Technical support provided to West Bengal Govt. for installation of 2no. of Rubber dam at Medinipur(WB)

different inflation height for a 5 m rubber dam in a stream of 8 m width at different slope of the channel is given in Fig-1.

The rubber dams installed in Odisha (4.1 to 5.0 m span in a stream of 8 to 10 m width) stored an additional amount of water in the range of 4000 to 10000 m³. During kharif around 80000 m³, 68000 m³ and 52000 m³ of water was diverted for irrigation to provide four irrigations to kharif crop in 40 ha area at Baghmari; 17 ha area at Chandeswar-1 and 13 ha area at Chandeswar-2 of Odisha respectively. During rabi season an additional 5 ha area could be irrigated utilizing the water stored in the rubber dam to grow pulses, oilseeds or vegetable. Also summer vegetable were taken up in 2 to 3 ha area during normal rainfall year. Over the years the ephemeral stream of Sagadianala gradually became almost perennial.



Rubber dam at Chandeswar-1
Khorda, Odisha

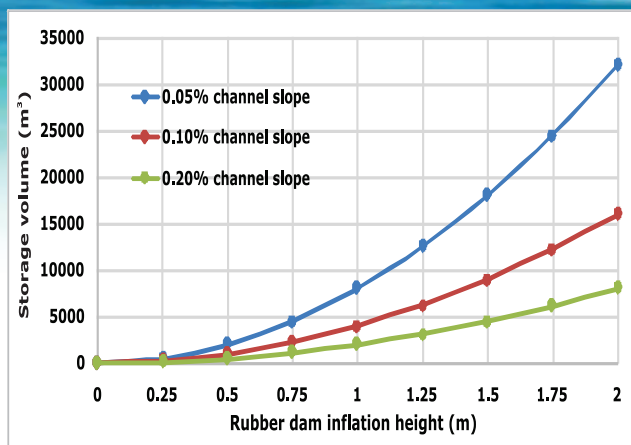


Fig. 1. Water storage volume with respect to different rubber dam inflation height at different slope of the channel

The distance of water storage in the upstream with reference to inflation height of rubber dam at different slope of the channel is given in Fig. 2.

Impact on income of the farmers and benefits over conventional system

Majority of farmers in the command area of the rubber dam at Baghamari and Chandeswar have small and marginal landholdings and before installation of rubber dam they were not able to generate good returns due to poor crop establishment and crop productivity. The adoption of technology has enhanced the rural livelihood options. The impact of the rubber dam on water storage, agricultural production, and socio-economic aspects is provided below in Table 2: This technology has enhanced the crop productivity, crop production, crop diversification, cropping intensity, and cultivated land utilization index thus increasing the rural income.

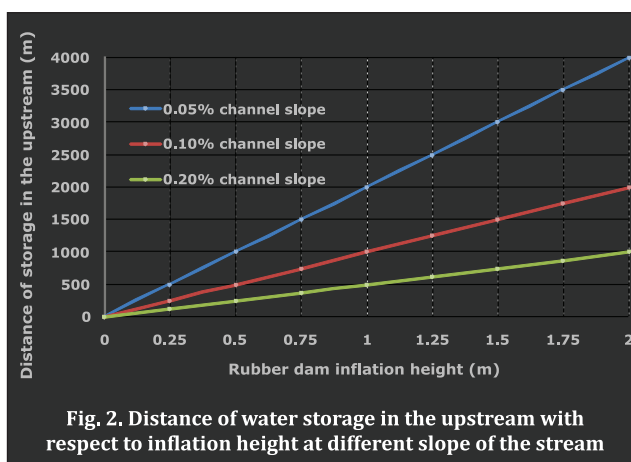


Fig. 2. Distance of water storage in the upstream with respect to inflation height at different slope of the stream

Table 2. Impact of rubber dam on water storage, crop production and socio-economic parameters

Parameters	Amount	Remark
Additional storage	4000 -10000 m ³	At any point of time
Additional area irrigated	13-17 ha	During kharif
	2-5 ha	During rabi & summer
Average productivity enhancement	2.87 t/ha to 4.67 t/ha	For paddy in kharif
	0.63 t/ha to 0.92 t/ha	For green-gram in rabi
	22 to 34%	Rabi & summer vegetable
Increase in cropping intensity	31%	
Cultivated Land Utilization Index	0.43 to 0.60	
Enhancing net returns	Rs. 44000 per ha	Rice-greengram cropping system
Benefit: cost ratio	2.30	
Internal Rate of Return	14.3%	Payback period of 3 years

Technology Dissemination

Witnessing the success of rubber dam in watersheds in different parts of the country, Govt. of Odisha, Govt. of West Bengal, Govt. of Kerala, Govt. of Telangana, and Private agencies from Gujarat, Delhi, Karnataka had shown their interest for installation of rubber dams in their states.

Technology commercialization

A memorandum of understanding has been signed between Indian Council of Agricultural Research (ICAR) and M/s. Forech Mining & Construction International LLP, Hilton House, S-23 Green Park Extension, New Delhi – 110016 for production and supply of “Technical Textile Reinforced Rubber Composite Sheets” for installation of “ICAR FLEXI CHECK DAMS”.

Limitation of the technology

The technical textile reinforced rubber composite sheet used in rubber dam

installation can be damaged by human being with a sharp knife having wrong intentions. However it will not be damaged by any natural events such as flood, cyclone etc. and not also by floating animal carcass, broken glass bottle, stones and pebbles, uprooted trees or bamboos coming with flood water. Similarly the rubber sheet can be damaged by fire.

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