Agricultural Engineering Today, Vol.22 (5-6), : 9-13, 1998

CHECK DAMS FOR RUNOFF HARVESTING AND ITS RECYCLING IN IRRIGATION IN THE EASTERN RED SOIL REGIONS

Kamal Misra*

ABSTRACT

Due to serve erosion problems, the Soil Conservation Department of Damodar Valley Corporation build check dams for runoff harvesting and its recycling in irrigation, in four villages, namely, Phuphund, Marpa, Telaiya and Thapai, of the catchment of the Damodar Valley. From the studies conducted it can be concluded that rainwater harvesting/recycling by check dams is the key to the development in the High Land Eastern Red Soils Region of the country. Check dam acted as a nucleus of all round development by assuring crop stand, due to the availability of water, changed new cropped area into double cropped area, changed subsistence agriculture to market oriented cash crop production, generated new employment opportunities, catalysed land reclamation and development, gave impetus to pisiculture, fodder and milk production. This phenomena can be replicated in the regions of similar topography and rainfall pattern all over the country.

1. INTRODUCTION

The eastern red soil region extends over the high lands of Bihar, Orissa, West Bengal, Madhya Pradesh and Andhra Pradesh and covers an area of 57.45 million hectares between longitude 80° to 87° 08'35" E and latitude 16° 47'08" to 25° 21'25" N. The topography is undulating and the annual rainfall usually varies from 1000 to 1500 mm, about 82% of which occurs during June to September. There are serious problems of sheet and gully erosion, heavy grazing, siltation of reservoirs, and above all, acute water shortage in the non-monsoon months in this high rainfall area due to a lack of appropriate technological intervention for land and water management.

The upper valley of the 540 km long Damodar river is situated in the eastern part of this region and is representative of the area. It covers an area of 1.751 million hectares (m. ha) lying between Long. 84° 7' to 85° 7' East and Lat. 23° 4' to 24° 4' North. The elevation varies from 300 to 600 m above mean sea level, with interspersed hills rising up to 1500 m. Soils are generally shallow, mostly of red soil group, highly leached and acidic in reaction and light textured. Out of the total area of 1.75 m ha, the area affected by erosion is 1.15 m ha. Out of this 0.40 m ha is severely affected by sheet erosion, 0.48 m ha is denuded and gullied forest and 0.265 m ha is gullied waste land.

* Director of Soil Conservation, Damodar Valley Corporation, Hazaribagh (Bihar), India

Damodar Valley Corporation (DVC) is an interstate organisation created in 1950 on the pattern of Tennessee Valley Authority of U.S.A., for the overall development of the Valley including flood control, electricity generation/distribution and soil and water conservation.

Due to severe erosion problems, the Soil Conservation Department of Damodar Valley Corporation is carrying out the integrated watershed treatment which includes protection/regeneration of forests, in situ moisture conservation, guilly control by various methods including check dams, monitoring of works by silt and runoff observation, soil conservation research, soil fertility analysis/recommendations and soil conservation training to technical personnel.

Surface water storage and recycling through check dams, a very important component of the integrated watershed management, has been discussed in this paper with the specific case study of an area in the Upper Damodar Valley. Some salient features of the study region are given in Table 1.

Table 1. Some salient features of the check dams and the study area in Upper Damodar Valley

Village and (code)	Catchment area ha	Storage ha.m.	Cost Rs. in lakhs	After check dam	
				Command area (ha)	Reclaimed area (ha)
Phuphundi (P1)	65	12	0.99	80	130
Phuphundi (P2)	12	2	0.24	10	6
Phuphundi (P3)	67	6	0.36	20	9
Phuphundi (P7)	22	4	0.26	10	6
Marpa (M3)	26	5	0.27	20	12
Marpa (M4)	24	4	0.22	15	10
Telaiya (T1)	30	6	0.51	20	15
Thepai (TH3)	20	4	0.28	15	12

2. PROBLEMS OF CROP PRODUCTION IN THE VALLEY AREA

Since, over 80% of the annual rainfall occurs during the four monsoon months of June to September and the terrain is undulating with medium to steeps slopes, much of the naturally incoming water flows out quickly as runoff. Moreover, the soils being light textured and very permeable, its ability to hold water in root zone is limited. Even during

the monsoon, the rainfall is erratic with a continuous 15 to 25 days of no rain. In the soil/ topography/rainfall regime of the area, a monsoon gap of even seven days is sufficient to cause moisture strees to the crops. Hence, in an average year, the main (monsoon) crop is not certain with complete failure in some years and 25% to 50% of the optimum yield in other years. And it is impossible to raise a second (winter) crop. But due to the increase in population and pressure on land, a single crop is a very serious waste of the land resources. Another important problem is the lack of farmer's interest in the proper care of the land due to poor returns.

3. INTEGRATED WATERSHED MANAGEMENT PROGRAMME AND CHECK DAMS

Construction of check dams in catchments of size up to 500 hectares and costing up to Rs.0.1 million is an integral part of the soil conservation programme in the valley. The DVC has developed the well tested technology for the investigation, survey and construction of such structures. In catchments up to 40 ha, these are simple, inexpensive, homogenous earth fill structures. Beyond 40 ha catchment area, various types and sizes of masonary spillways such as drop inlet, straight drop and multiple straight drop spillways are constructed. Every year five hundred structures are constructed and a total of approximately nine thousand such structures have been constructed since the inception of the watershed management programme.

The check dams create a local water storage and the DVC is training and helping the farmers in proper water management to utilize this created storage for crop production and pisciculture.

The check dams have been found to have impact on soil and water conservation, reduction of sediment inflow into downstream reservoirs, crop production due to the use of stored water in irrigation, ground water recharge, employment generation, flood modulation etc.

The impact of check dams on crop production has been studied in detail in four villages, namely, Phuphundi, Marpa, Telaiya and Thepai, of the catchment number Kdlf (Total area : 5200 ha in 36 villages) of the Upper Damodar Valley, and these case studies are presented in this paper (Table 1).

4. METHODOLOGY

The information with respect to crop types and their cultivation, costs and returns were collected, both prior to and after the construction of the check dams. The cost analysis has been done for the cost of cultivation and irrigation at the existing price level of 1995. Economics of water harvesting has been given the maximum weightage and the

economic analysis of the water harvesting system is based on Benefit – Cost ratio. In economic analysis of these check dams, initial costs, benefits and maintenance have been calculated. The cost of reservoirs, irrigation systems, cost of cultivation (including material and labour cost) have been considered while doing economic analysis.

5. RESULTS AND DISCUSSION

Irrigation through the harvested runoff water in the small reservoirs behind each check dam has brought a total change in the cropping plan of the area. The production of inferior local millet has been discontinued and cash crops such as potato, wheat and mustard have been introduced. There is also an increase in the cropping area under pulses which has proved to be quite remunerative. All the relevant details are given in Table 2.

Table 2. Economic analysis of crop cultivation before and one year after check dam construction in the study area

Crop	Area (ha)		Cultivation cost (Rs. lakhs)		Crop yield (Qtl.)		Value of produce (Rs. lakhs)		Net income (Rs. lakhs)	
	Before	After	Before	After	Before	After	Before	After	Before	After
Rainy season crop										
Paddy	60	100	1.80	4.50	900	2500	3.15	10.00	1.35	5.50
Maize	10	25	0.20	0.75	110	450	0.28	1.35	0.08	0.60
Minor millet	30	5	0.30	0.05	150	25	0.30	0.05	Nil	Nil
Pulse	5	10	0.06	0.25	20	60	0.26	0.90	0.20	0.65
Potato	Nil	25	Nil	7.50	Nil	3750	Nil	22.50	Nil	15.00
Winter season crop										
Paddy	Nil	10	Nil	0.50	Nil	200	Nil	0.80	Nil	0.30
Wheat	Nil	60	Nil	4.20	Nil	900	Nil	4.95	Nil	0.75
Potato	Nil	25	Nil	8.00	Nil	6250	Nil	18.75	Nil	10.75
Mustard	Nil	15	Nil	0.45	Nil	90	Nil	1.44	Nil	0.99

The area under paddy has increased by 133%, in case of wheat entirely new area of 80 ha has been added. The decrease in the area under local inferior millet is 83.33%. The increase in the area of *Urad* pulse is 100%.

The net income before the project implementation was only Rs.0.162 million which has now gone up to Rs.3.454 million and therefore Rs.3.2915 million is the additional income in the area due to the check dams. There also has been a marked change in the cost of cultivation. The farmers have increased the inputs considerably as is evident from Table 2, and as a result, there is a considerable increase in the crop yield.

Further analysis has revealed that the total cost of the check dams and the irrigation systems comes to Rs.0.413 million, whereas the additional income generated from crop production by using the stored water in the reservoirs of the check dams in irrigation is Rs.3.2915 million. Hence, the cost of the dams and irrigation system could be recovered in just one year after the construction of the check dams and installation of the irrigation facilities. The benefit/cost ratio comes to 1.32 excluding the reservoirs and irrigation system and it comes to 1.14 if the capital cost of providing the check dams and irrigation system are considered. It was also calculated that the benefit : cost ratio will increase to greater than 3 at a later stage i.e. after 5 years because the value of the capital costs gets distributed over the years. The benefit : cost ratio mentioned above may be considered only partial as the benefits from non quantifiable items such as soil conservation, water conservation, flood modulation, water regime improvement etc. have not been considered. Also certain quantifiable benefits that has accrued in the post construction period due to increased agricultural activities, such as, increased milk, fish and fodder production etc., have not been included in this study.

6. CONCLUSION

After this case study and results of other similar case studies it can be concluded that rain water harvesting/recycling by check dams is the key to the development in the High Land Eastern Red Soils region of the country. Each and every check dam acts as a nucleus of all round development. Assured crop stand due to the availability of irrigation water has changed a mono cropped area into a double cropped area, changed subsistence agriuclture to market oriented cash crop production, generated new employment opportunities, catalysed land reclamation and development, gave impetus to pisciculture, fodder production and milk production. Another important aspect is that this phenomenon is self sustaining i.e. it can be funded by the farmers themselves with bank financing and the Government aided projects can act as demonstration projects. The phenomenon can be replicated in the regions of similar topography and rainfall patterns all over the country.