Young Scientist- Tomorrow's Science Begins Today
Vol. 5, Issue 1 – 2021
ISSN: 2581-4737

Biomass Productivity, Crop Yield and Socio-Economic Status of Madhoganj Block Watershed of the District Hardoi as Influenced under Various Soil and Water Conservation Measures

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Abstract

A field study was conducted on biomass productivity and crop yield changes in relation to soil and water conservation practices in selected watershed of district Hardoi (U.P.) India. The results achieved after three years of study shows that soil and water conservation measures have influences crop yield and biomass productivity compared to initial year values in the study area. It is obvious from the data of pre and post-project period of various resource from bench mark survey obtain that the average socio-economic status of rural population has been improved due to soil and water conservation practices adopted in selected area. The stakeholders in the study area are marching towards self-dependence in their needs by the introduction of scientific cropping and timely managing their input resource by creating the awareness among them. It was observed that growing cover crops like cowpea in *Kharif* followed by gram in *Rabi* in combination with fodder crops found to be effective for increasing crop yield as well as biomass productivity under scares moisture condition.

Keywords: Biomass, yield, soil conservation measures, socio-economic status.

Introduction

Conservation agriculture systems require higher levels of biomass production within the rotation to develop and maintain an adequate mulch cover, to increase soil organic matter level, to enhance soil biodiversity and their functions, to raise moisture and nutrient holding capacity, to enhance nutrient supplies, to enrich the soil with nitrogen in the case of legumes and to protect the soil surface. Agricultural practices that enhance soil organic matter are built into conservation agriculture principle and include one or more of the practices, including, minimal or no-till,

diversifying cropping systems, planting trees, mulching, using cover crops and green manures, using crops rotations and nitrogen fixing crops.

Generally speaking, mechanically or engineering measures form the first line of defense to arrest soil erosion immediately; mechanical measures on agriculture, watersheds are limited to contour bunding, land leveling, graded bunding and bench terracing on steep slopes. Contour bunding can be adopted on almost all the soil of the country receiving an annual rainfall up to 600 mm and having adequate infiltration rate. Contour bunding in agricultural watersheds of many regions is found to reduce surface runoff and soil erosion considerably.

The very common conservation structures in the watersheds are gully plugs and nala bundhies/check dams. These structures are constructed with the objective of stabilizing gullies/nalas and increasing ground water recharge. The water stored in the gully plug structures and check dames can be used to increase production. For effective soil conservation, the agronomic measures have to be considered in integration with mechanical measures and not in isolation. Agronomic measures help to reduce the impact of rain drops through inter option and thus reduce splash erosion. These practices also help to increase infiltration rates and thereby reduce runoff and overland flow. Reduction in runoff and losses could be achieved through land management practices and associated agronomic practices.

The population of the district Hardoi is 40.91 lakhs, with a rural population of 29.90 lakhs and a ratio of 856 females per 1000 males. About 74 percent of the population is below poverty level as per the BPL survey of Ministry of Rural Development, Government of India. The major field crops of the district are paddy, wheat, maize, mustard and groundnut, with potato and onion being the principal vegetable crops. Productivity of all the crops in the district is below the state average. Excessive land degradation due to erosion and soil salinity/sodicity is curse the district. Hence, the present investigation was undertaken to study the effect of conservation measures on biomass productivity and crops yield and on socio-economic conditions of local inhabitants. Chambal ravines represent the most degraded form of ones cultivated fertile land the ravine land was severely eroded by runoff water and very poor in physio – chemical properties. Bhan, S. and Arora, Sanjay. (2019).

Materials and Methods

The present investigation was conducted during the year 2008-2011 with the objective to study the effect of various conservation measures on biomass productivity and crop yield and on socio-economic conditions of local inhabitants. The district Hardoi comes under central region of Uttar Pradesh. The district lies between the parallels of 26º53" to 27º46" North latitude and 79º41" and 80º46" East longitude. The experimental watershed was situated in Madhoganj block of the district. Climate of the Hardoi district is semi-arid with mean maximum and mean minimum temperature of 32ºC and 23ºC, respectively. The rainfall pattern of district is highly erratic with the mean annual rainfall of about 800 mm. Treatment consists of ten soil and water conservation

measures namely contour cropping (on the field having < 2.00 % slope):maize in *Kharif* followed by wheat crop in *Rabi* was grown on contour in each year, strip cropping (across the solpe):long and narrow strip of erosion resisting crop (urd followed by gram) alternate with strip of erosion permitting crops (bajra and wheat), cover cropping:cowpea (*Vigna sinensis*) was grown as cover crop grown in *Kharif* season and gram in *Rabi*, inter cropping: maize and wheat (erosion permitting crops) was grown with mung bean and gram (erosion resisting crop) as intercropping on field where slope was < 2 %, silvi-pastural: tree and shrub species like subabool was grown with napier grass both as a fodder crops, agri-horti: mung bean in *Kharif* and gram in *Rabi* season was grown with guava in selected area, vegetative barriers: *Leucaena leucocephala* and mung bean was grown as vegetative barriers, precision land leveling: done by using tractor driven laser leveler machine and maize - wheat cropping sequence was adopted, bunding: in bunded areamaize and wheat cropping system was adopted, gully plugging: maize-wheat cropping system was adopted for gully plugging. Treatments as per plan were applied and experiment being carried out year after year (2008-2011). Base line data were collected through bench mark survey from selected farmers at village level to study the biomass productivity and socio-economic status of the target groups of the region. The survey data was taken from the starting point of all development and research activities. The survey report forms the basis of comparison between pre and post project status, evaluation and monitoring of the project. The change due to project was measured using the baseline information of the crop yield, biomass productivity and socio-economic status after research work. For socio-economic status analysis tool of study was a structured interview schedule which was developed for collection of data from different respondent. Information was collected through personal interview method of enquiry by researcher himself. The purpose of interview was clearly explained to each respondent. Data were collected from March 2009 to June 2011. The data collected through personal interview method were classified, tabulated and analyzed with the help of statistical tools. The collected information was analyzed and interpreted. To calculate the percentage, the frequency of a particular cell was multiplied by 100 and divided by the total number of respondents in that particular category. The percentage was worked out in the following manner.

$$\text{Percentage} = \frac{\text{Number of respondents belonging to particular category}}{\text{Total number of respondents}} \text{ x100}$$

Results and discussion

Biomass productivity and crop yield during *Kharif* season

Data presented in table 1 shows that various soil and water conservation measure practices influenced crop yield and biomass productivity in the project area of watershed when compared with initial years. It is clear from the data that in case of cover cropping crop yield increased 44.00% in cowpea crop and least increase in yield was observed under gully plugging (8.88%). The order of response was cover cropping >strip cropping >inter cropping >contour cropping>vegetative barriers >precision land leveling >bunding and gully plugging. In case of

biomass productivity, the maximum per cent increase was observed under cover cropping (42.21%) followed by vegetative barriers (29.8%) and lowest under gully plugging (7.63%). Among the various soil and water conservation practices cropping systems cover cropping treatment of cowpea and gram exhibited positive effect as compared to other adopted practices like bunding and gully plugging, probably this may be due to more conservation of soil moisture, less runoff, soil loss and availability of more nutrient to the succeeding crops in the project area, these results corroborate with the findings of Akonde *et.al.* (1996), Palled *et.al.* (1997), Isola *et.al.* (1998), Chand and Bhan (2000), Gupta *et.al*. (2006), Sharanappa *et.al.* (2006) and Susama *et.al.* (2008).

Biomass productivity and crop yield during *Rabi* season

It is evident from the data given in table 1 that in case of cover cropping crop yield increased by (31.79%) followed by agri-horticulture system. Lowest increase in crop yield was observed under gully plugging (2.97%). It is worthwhile to mention here that intercropping of wheat + mustard with 9:1 ratio of crop, the higher crop yield as well as biomass yield was recorded. The increase in crop yield was observed in soil and water conservation practices in the order of intercropping > cover cropping > contour cropping > strip cropping >agri-horticulture > precision land leveling > bunding and gully plugging. Among the biomass productivity the maximum increase was recorded under intercropping (40.20%) and lowest under gully plugging (2.26%). However, silvi-pastural system (subabool + Napier) produced higher biomass of (24.8%) in comparison to initial values. The maximum total biomass production was recorded in cover cropping system followed by vegetative barriers. However, under different agro-forestry systems like; silvi-pastural system recorded maximum biomass production in comparison to other system adopted in the project area. This might be due to reason that subabool + napier grass grown for fodder purpose which was multi-cut in nature. These results may also be supported by the findings of Akonde *et.al.* (1996), Palled *et.al.* (1997), Isola *et.al.* (1998), Chand and Bhan (2000), Gupta *et.al*. (2006), Sharanappa *et.al.* (2006) and Susama *et.al.* (2008). The rice in water table after conservation of rain water and also enhancement of ground water recharge by soil and water conservation measure have been reported by (Paul et. al. 2016 and Singh et.al 2018).

Impact on socio-economic status

The average productivity of cow, buffalo and goat has been found to increase from 2.2 to 2.8, 3.4 to 4.2, 0.5 to 0.60, respectively (Table 2). The percentage increase in cow, buffalo and goat was 27.27, 23.52 and 20.0, respectively. Due to the watershed development programme and the gradual change in mindset of the people resulted into the increase in number of livestock in project area. It is evident that the migration pattern in villagers was in decreasing trend due to the availability of a greater number of employments, opportunities to the local people in the project area during post project period. In case of migration pattern the maximum reduction in migration of people was observed under working population followed by agriculturist and minimum under labour (Table 3). Meena et.al. (2017) concluded that implemented engineering measure in

watershed programme were found to be accepted and continuously maintained to a greater extend by the farmer.

Table 2: Change in livestock productivity (litre/animal) of milk

S. No	Livestock	Pre-project Production (2008)	Post-project Production (2012)	(%) Increase(+) of decrease (-)
1.	Cow	2.2	2.8	27.27(+)
2.	Buffalo	3.4	4.2	23.52 (+)
3.	Goat	0.50	0.60	20.00 (+)

Table 3: Changes in migration pattern (%) of the native population to cities

Sl. No.	Particulars	Migration Pre-project (2008)	Migration Post-project (2012)	(%) Increase(+) of decrease (-)
1.	Working population	5	3	40 (-)
2.	Agriculturist	6	4	33.3 (-)
3.	Rural artisans	3	2	33.3 (-)
4.	Land labours	20	15	25 (-)
5.	Other	8	6	25 (-)
6.	Total	42	30	28.6 (-)

Table 4: Change in the average family income after implementation measures

Sl. No.	Particulars	Pre-project (2008)	Post-project (2011)	(%) Increase (+) or decrease (-)
1.	Agriculture	20127 (60%)	22180	10.2 (+)
2.	Livestock	6665 (20%)	7610	14.2 (+)
3.	Income from wages	6892 (20%)	8112	17.7 (+)
4.	Total income/family	33684	37902	12.5 (+)

As regard productivity and family income in project period was found to increased from 10.2 to 14.2% (Table 4) in agriculture and livestock respectively and overall increase in family labour was recorded up to 12.5% which have been ultimately help full in increasing the standard of living, purchasing power and socio-economic status of the farming communities in project area. The result obtained by the bench mark survey during post project period clearly indicates that the practices and systems adopted in the project area resulted significant changes in the indebtedness of farming communities due to enhancement in the productivity level as well as awareness about the judicial use of input and proper marketing of the farm produce and also value addition and least losses in post-harvest was observed which has ultimately reduced the dependency on financial institution and money lenders. It was also noticed that a smaller number of families were interested in credit from the banking sector and money lenders because of enhancement in their income from the majors and techniques adopted in the project area. It was observed that significant changes in the livestock pattern and their productivity was noticed, which resulted

overall increase in family income, which ultimately improve the socio-economic status of the farming communities, this reduce the dependency on financial institutions and money lenders. The main reasons for above development was adoption of improved techniques and technologies by the beneficiaries in the project area. These results are supported by the finding of Agnihotri *et.al.* (1990), Arya *et.al.* (1992), Dhar (1992), Mahant *et.al.* (1992) and Diwate*et.al.* (2002).

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Young Scientist- Tomorrow's Science Begins Today
Vol. 5, Issue 1 – 2021
ISSN: 2581-4737

Table 1: Effect of various soil & water conservation practices on crop yield and biomass productivity

Treatment	At start of the project			After completion of 3 years of the project			% Increase	
	Grain /seed yield (q/ha)	Stover/ fodder yield (q/ha)	Biomass productivity (q/ha)	Grain /seed yield (q/ha)	Stover/ fodder yield (q/ha)	Biomass productivity (q/ha)	Crop yield (%)	Biomass producti-vity (%)
Contour cropping Kharif – Maize Rabi - Wheat	 14.79 22.50	 42.25 29.25	 57.04 51.75	 17.20 28.6	 48.50 36.32	 65.70 64.92	 16.30 27.11	 15.18 25.44
Strip cropping Kharif – Bajra + Mungbean Rabi – Wheat + Gram	 6.95+2.25 16.5+1.5	 22.58+4.27 21.45+2.62	 36.5 42.07	 8.36+2.95 19.25+2.05	 26.75+5.45 24.06+3.52	 43.51 48.88	 22.90 18.30	 17.21 20.70
Cover cropping Kharif – Cowpea Rabi – Gram	 5.25 7.8	 10.97 13.65	 16.22 21.450	 7.56 10.28	 15.49 17.99	 23.05 28.27	 44.00 31.79	 42.21 31.80
Inter cropping Kharif – Maize+Mungbean (5:1) Rabi- Wheat + Mustard (9:1)	 18.50+2.15 6.27+2.75	 24.75+6.66 19.43+5.77	 53.06 34.22	 21.65+3.10 8.17+3.85	 27.06+6.60 25.00+7.97	 58.41 47.99	 19.9 33.3	 10.08 40.20
Silvi – pastural Subabool + Napier grass (Fodder)	-	- 90+5.75	 665.00	 -	105+7.25 -	 830	 -	 24.8
Agri- Horticulture Kharif – Guava + Mungbean Rabi –Guava + Gram	35kg/T/ year+2.08 /+1.25	 0+6.44 0+2.18	 8.52 3.43	45kg/T/yea r+2.76 0+1.50	 0+8.30 2.58	 11.06 4.08	28.6 fruit yield +28.9	 29.8 18.9

Vegetative barrier								
Kharif – Subabool + Mungbean	0+3.78	8.2+11.71	73.69	0+4.26	71.2+2.82	88.28	12.70	19.8
Rabi – Subabool + Fallow	-	-	-	-	-	-	-	-
Precision land leveling								
Kharif – Maize	14.79	42.25	57.04	16.58	46.92	63.50	12.16	11.30
Rabi – Wheat	22.50	29.25	51.75	26.50	33.15	59.62	17.17	15.20
Bunding								
Kharif – Maize	22.5	29.25	51.75	26.20	33.01	59.13	16.44	14.30
Rabi – Wheat	14.79	42.25	57.04	16.12	45.62	61.74	8.99	8.24
Gully plugging								
Kharif – Maize	22.5	29.25	51.75	24.5	30.87	55.70	8.88	7.63
Rabi – Wheat	14.79	42.25	57.04	15.23	43.10	58.33	2.97	2.26

* Fruit yield not included as a biomass.

