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Assessment Of Socio Economic Impacts Of Pandoga Sub Watershed In Rain Fed Agricultural Area Of Shivalik Region Of Una(Himachal Pradesh), India

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ABSTRACT: *Socio economic characteristics of Pandoga sub watershed catchment area shows that respondents prefer to settle with respect to caste had minimum ten year school of education; pakka house was the type of house while agriculture was the main occupation of the area. Income per annum maximum observed was 1, 00,000 in all sites. The size of land holdings were as Less than one hectare was maximum 81.5% in site2.Irrigated land was observed maximum in site3 with 88.2% However un- irrigated land was observed maximum in site 2 with 88.9%while minimum in site 3 with the 5.9%. Irrigation through the bore well was maximum in site3 with the 61.8% while minimum irrigation was in site 2 with 14.8% through bore wells. Maize in Kharif and wheat in Rabi seasons were the most important crops grown by the farmers in both the period. However maximum percentage of other crop (potato crop) was found in site3 with the 85.3%. This change may be due to differential increased in water availability in sites. Mechanized farming was adopted by respondents of site 3 with 88.2% however traditional method of farming was preferred by the respondents of site 1 with the 57.9 %.Fertilizer as a way for farming was preferred by the site1 with the 100.0% which was followed by the site3 and at last by site 3.Manure as a way of farming was preferred in site1 with 100.0% followed by site 2 and site 3 with the 85.2% and 82.4%, respectively from site 1 to site3.*

KEYWORDS: *pandoga sub watershed, rainfed agricultural area, socio economic*

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I INTRODUCTION

Globally, rain fed agriculture plays an important role to achieve food security (Rockstrom *et al*., 2007) as 80% World's agricultural land area is rain fed and generates 58% of the world's staple foods SIWI (2001). India is one of the major rainfed agricultural countries as out of 141 million hectare net area sown; about 100 million hectare of land was remained rainfed (Tripathi *et. al*., 1990) contributed about 42% of the total food grain production in the country. The rain fed areas are the hot spot of poverty, malnutrition, water scarcity, severe land degradation. These areas are lacks technologies and necessary resource to cope with the challenges of global warming. The vast potential of rain fed areas remains untapped as the current farmer's crop yields are lower by two to five folds than the achievable yields with large yield gaps in the semi arid and sub-humid tropical regions (Rockstrom *et al.,* 2007; Singh *et al*., 2009).

The watershed management approach adopted to conserve rainwater, minimize land degradation, and improve groundwater recharge, increase crop intensity and productivity (Kerr *et al.,* 2000). To achieve food security, minimize water conflicts, and reduce poverty it is essential to increase productivity at rain fed system by harnessing the existing potential (*Wani et al.,* 2003).In marginal rainfed areas where the resource base has been subjected to degradation, integrated management of soil and water resources is imperative in order to enhance the productivity of agriculture and improve the well being of people.

Himachal Pradesh has been categorized in Zone I (Western Himalayan region). Shivalik are one of the five micro-endemic centers of Himalaya. The Shivalik ranges have been identified as one of the eight most degraded rain-fed agro ecosystems of the country and among the youngest hills in the world and are active as well as fragile. This fragile ecological system is vulnerable to soil erosion, land slips and landslides with sparse vegetation cover, seasonal floods and drought and other environmental threats as erratic rainfall results into frequent crop failure and poor livelihood condition of agrarian communities of the area.

Rain fed agriculture is the prevalent production system in Shivalik. Swan River catchment of Una district of in Una district H.P fall in Shivalik ranges so had similar rainfed agricultural area. There has been little research on impact of watersheds in country but Una district of Himachal Pradesh till date remains untouched in the context of socio economic assessment of sub watershed impact. Therefore research proposal is planned to assess physical and socio-economic impact of sub watershed on study area (Pandoga gram panchayat) in Una district of Himachal Pradesh.

II MATERIALS & METHODS

3.2.3Description of Study area

The present study was conducted at Pandoga sub watershed catchment area. This sub watershed was intervened in 2007-08 under the SRIWMP (Swan River Integrated Watershed Management Project). This implementation has significant importance in district because study area is a part of Shivalik foot hills. The Swan River, a tributary of Sutlej, is the main river of area but known for havoc as it create floods in the catchment during monsoon periods so known as "river of sorrow". SRIWMP launched to control the flood hazards and to convert the river as natural gift to the people of Una district in H.P (India). Pandoga sub watershed was one of the treated watershed was selected for present study through random selection method.

Pandoga gram panchayat consists of 12 wards with an area of 1745 ha. Catchment area of Pandoga sub watershed is 2300 Ha. The Pandoga sub watershed was located at 31^0 30'25.30"N Latitude and 76^0 82' 02.24" E longitudes. Elevation of area is 350 to 600 m above mean sea level. Topography of the area is gentle to moderately sloping. Mean annual rainfall is approximately 1155mm with extreme variation in rainy and post rainy season. Temperatures also vary from high in summer season (May to June) to low in winter season.

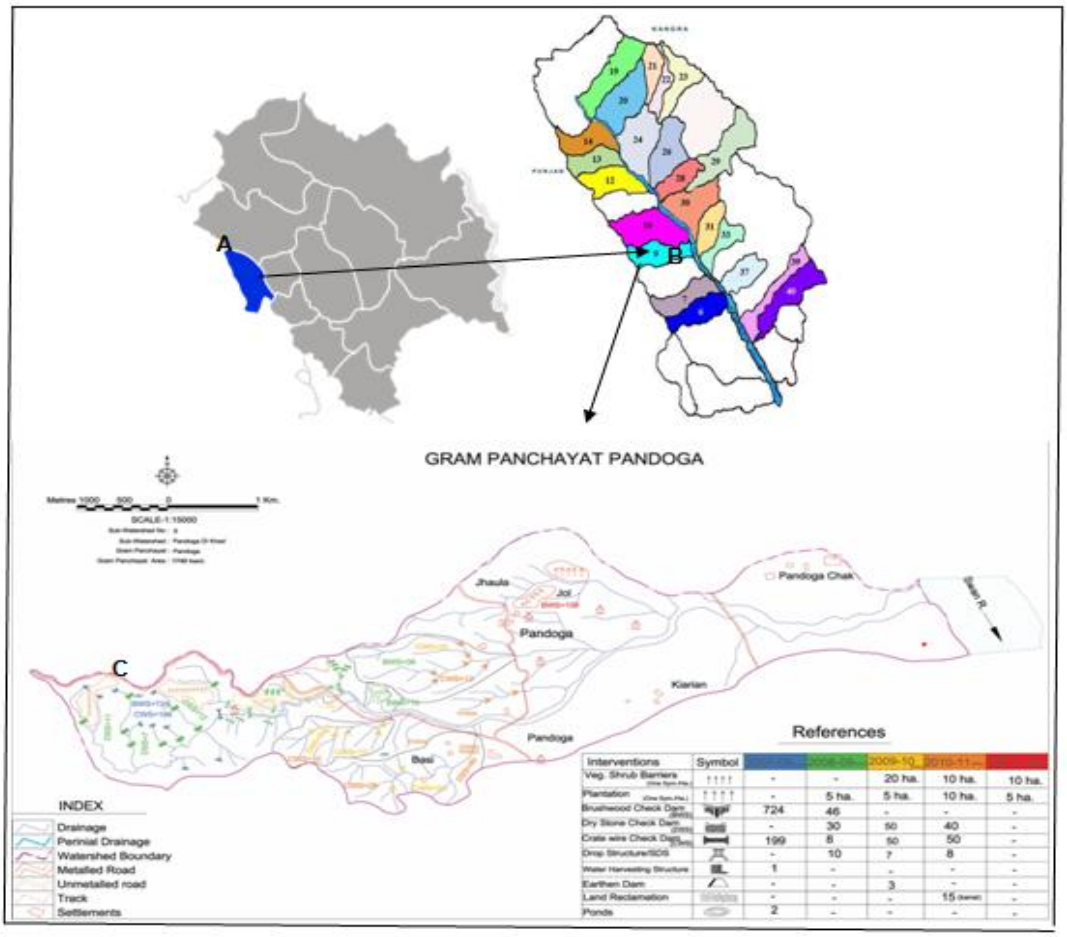

Fig.1: Location map A. Distt. Una in Himachal Pradesh; B. Swan River watershed project area; C. Pandoga sub-watershed catchment area

III DATA COLLECTION FOR SOCIO ECONOMIC CHARACTERISTICS

Intensive fieldwork was undertaken to interact and to do group discussion with Gram Panchanyat Pardhan, Panchs (smallest unit of local administration) and local house hold families at survey sites comprising wards in 2nd week of October 2014 to the end of December 2015.Selection of 10% of total households from each ward by convenient sample surveying method. Data of households in wards were obtained from statistical sources and pardhan of village. Categorize the sample households into the respective groups for group discussion. Information was collected following primary as well as secondary data collection method. Collected data of information was then statistically analyzed.

IV RESULTS &DISCUSSION

Socio economic characteristic analysis might provide grass root level realities in terms of different status prevailing in particular time and region. Socio economic characteristic results discussed as

1. Physical impacts

Biological and mechanical measure was taken up by sub watershed management authority to control floods, droughts and soil erosion. Drainage line treatment, dry stone check dams and crate wire check dams taken up to in-situ conservation of rainwater and to prevent the soil erosion (Fig.2A-C). It ultimately lessened the velocity of water flow in the stream/gully which reduced sediment transfer to the water harvesting structure. It contributed for livelihood security and the ecosystem sustainability as downstream had not experienced flood after the dam construction.

2. Socio economic impact

2.1Caste

Caste was an important indicator of socio economy to portray the way of living and their settlements in the society. Frequency percentage results showed that 84.2% respondents belonged to General caste in site 1 while SC caste was not observed. OBC caste was observed maximum with 40.7% respondents in site2 whereas in site 3 with 100 %(Table1). Results indicated that settlements influenced by the caste system in the study area. Singh (2000) studied the relevance of socio-economic household on watershed by gathering data on caste, economic groups. Chi square result showed that null hypothesis ($1H_0A$) was rejected at 5 % (0.005) level of significance for site 1 and site 2 with the caste while accepted for site3 with the caste (Table 2). It showed that there was some significant relationship between site 1 and site 2 with the caste but there was no significant relationship between site 3 and with caste (Table 4).

2.2Education and Type of house

Education plays a pivotal role in the overall growth and development of any country. Level of education affects the planning and managerial abilities of the farmer in decision making. Frequency percentage results show that 10^{th} standard had highest frequency in site1 and site 2 with the 47.4% and 44.4% respectively. In site 3, maximum frequency percentage was observed for 12^{th} standard with the 70.9% (Table 1.).Results showed that all respondents had minimum required education (ten years of schooling). Lack of higher educational institutions or far located institutions, poor economic condition and lack of professional skill institution may be the conspicuous reason for low percentage of higher education in the study area. Demeke, (2009) also studied education level in Ethopia. Chi square results showed that null hypothesis ($1H_0A$) was accepted at 5 %(0.000) level of significance for site 1, site 2 and site 3. It showed that there was no significant relationship between site 1, site 2 and site 3 with the education (Table 4).

The volume of investment on buildings reflects the economic soundness of a farm family. Frequency percentage results shows that Pakka house was observed maximum in all sites (68.4%, 55.6%, 55.9%) as a type of house. Hut was observed 3.7% in site 2 only while it was missing from other sites. Semi pakka type of house was observed maximum in site 3 with the 44.1% frequency percentage (Table1). Same results were observed by (Thakur *et al.,* 2014). Chi square result shows that null hypothesis ($1H_0A$) was rejected at 5 %(0.000) level of significance with the type of house and site 1, site2 and site 3. It showed that there was no significant relationship between site 1, site 2 and site 3 and type of house (Table 4)

Table1: Frequency percentage of caste, education, type of house at Pandoga sub watershed catchment area

Caste	Site1	Site2	Site3	Education	Site 1	Site2	Site3	Type of house	Site1	Site2	Site3
SC	0	22.2	0	10^{th}	47.4	44.4	5.9	Hut	0	3.7	0
OBC	15.8	40.7	100.0	12^{th}	31.6	25.9	70.9	Semi pakka house	31.6	40.7	44.1
General	84.2	37.0	0	Graduate	21.0	29.7	23.5	Pakka house	68.4	55.6	55.9
Total	100	100.0	100.0	Total	100.0	100.0	100.0	Total	100	100	100

SC=Schedule caste, OBC= other back ward caste

2.3Source of drinking water and sanitation

IPH Department had highest Frequency percentage as the source of drinking water. Maximum respondents were observed in site 3 with the 70.6 % frequency while in site 1 and site2 with the 68.4%, 66.7% frequency percentage respectively. However minimum preferred source of drinking water was open well with the 15.8%, 11.1%, and 2.9% in site 1, site 2 and site3 respectively. (Table2). Besides alternative sources of drinking water respondents preferred improved sources of water provided by IPH department as other require labour. They had the opinion that open wells are not well maintained, regularly used as well as most closed by roofs for safety reason. Habtamu (2011) also studied the source of drinking water during case study of Lenche

Dima, Tsegur Eyesusand Dijjil watershed. (Fig. 3A-C).Chi square result showed that null hypothesis ($1H_0$ A) was rejected at 5 %(0.000) level of significance for site 1 and source of drinking water. It showed that there was some significant relationship between sites 1 and source of drinking water. However Chi square null hypothesis ($1H_0$ A) was accepted at 5 %(0.000) level of significance for site 2 and site 3 and source of drinking water. It showed that there was no significant relationship between site 2 and site 3 and source of drinking water (Table4).

A toilet was preferred over open system of sanitation in all sites. Out of total respondents 85.3 %(maximum frequency percentage) in site 3, 78.9% in site 2 and 1 used defecate in privately constructed latrines. Open system of defecation or sanitation was observed in all sites but with the lower frequency percentage (21.1, 22.2, and 14.7%) respectively in Table2. Chi square result showed that null hypothesis ($1H_0$ A) was accepted at 5 % (0.000) level of significance for all selected sites and sanitation. It showed that there was no significant relationship between sites and sanitation (Table4).

Table 2: Frequency percentage of source of drinking water and sanitation at Pandoga sub watershed catchment area

Source of drinking water	Site1	Site2	Site3	Sanitation	Site1	Site2	Site3
Open well	15.8	11.1	2.9	Open	21.1	22.2	14.7
Bore well	15.8	14.8	26.5	Toilet	78.9	78.9	85.3
IPH Department	68.4	66.7	70.6	Total	100.0	100.0	100.0
Other	0	7.4	0				
Total	100.0	100.0	100.0				

2.4Occupation and Income per anuum

The occupational pattern reveals the type of work available and adopted by respondents to earn money. Agriculture was highest in site 3 with the 58.8 % frequency percentage followed by site 1and site2 with the 47.4 % 44.7 % respectively. Business as a occupation was observed minimum in site3 with the 8.8% while in site 1 and site 2 business was a third option with the 15.8 and 18.5% frequency percentage respectively(Table3). Results show that agriculture was the prominent system of occupation in all sites. Singh (2000) studied the socio-economic household in watershed. Chi square result shows that null hypothesis was ($2H_0$ A) was accepted at 5 %(0.000) level of significance for all selected sites and occupation Table (4). It shows that there was no significant relationship between sites and occupation.

Income level represents the standard of living of any society. Results show that58.8% frequency percentage had 1,00, 000 income per annum in site 3 while 47.4% respondents in site 1 and 44.4% respondents in site2. <3,00,000 per annum was the second most income per annum earning of the respondents in all sites but maximum respondents were from site1 with the 36.8% followed by site 3 and site2 with the 14.7 % and 3.7%. No response was observed for 30,000 incomes per annum (Table3).Singh (1999) studied the impact of watershed management efforts on the farmer's income. Padmavathi and Reddy (2002) studied the personal and socioeconomic characteristics in National Watershed Development Project for Rain fed Areas. Chi square result of present study shows that that null hypothesis ($2H_0$ A) was accepted at 5 %(0.000) level of significance for all selected sites and income per annum. It shows that there was no significant relationship between sites and income per annum (Table4).

Table3: Frequency percentage of occupation and Income per anuum in Pandoga sub watershed catchment area

Occupation	Site 1	Site2	Site3	Income per annum	Site1	Site2	Site3
Agriculture	47.4	44.7	58.8	<30,000	0	14.8	2.9
Business	15.8	18.5	8.8	<50,000	15.8	37.0	23.5
Other	36.8	37.0	32.4	1,00,00	47.4	44.4	58.8
Total	100	100.0	100.0	<30,000	36.8	3.7	14.7
				Total	100.0	100.0	100.0

Table4: Chi square analysis between caste, education and type of house, source of drinking water, sanitation, occupation, income per annum with the site1, site2 and site3 at Pandoga sub watershed catchment area

Site	Site 1	Site2	Site3
Caste	*	*	Ns
Education	Ns	ns	Ns
Type of house	Ns	ns	Ns

Source of drinking water	*	ns	Ns
Sanitation	Ns	ns	Ns
Occupation	Ns	ns	Ns
Income per annum	Ns	ns	Ns

ns=non significant,*=significant

2.5Type of land holdings and Type of land holding 1

Farmers get land smaller in size due to sub-division from generation to generation. Therefore per capita land-man ratio was decreasing constantly and putting more stress on land. Less than one hectare land holding was shown by maximum (81.5%) frequency percentage respondents in site2 while minimum (68.4 %.) respondents was observed in site1 for less than one hectare. One hectare land holding was observed maximum in site1 with the 31.6% frequency percentage respondents while minimum respondent was observed for the site 3. Response for more than one hectare was observed maximum in site3 with the 5.0% while no response was observed in other two sites (Table5).Chi square result shows that null hypothesis ($2H_0$ A) was accepted at 5 %(0.000) level of significance for all selected sites and type of land holding. It shows that there was no significant relationship between sites and type of land holding (Table8).

Cultivated land (Type of land holding1**)** was found maximum in site1 and in site2 with 100%frequency percentage respondents while 94.1% land was cultivated land in site 3. Varat (2013) analyzed the changes in land use, cropping pattern, ground water table, irrigation, productivity of crops etc. of watershed development programme in village Mandhwan of District Ahmednagar.

Table 5: **Frequency percent of type of land holding and Type of land holding 1 at Pandoga sub watershed catchment area**

Type of land holding	**Site 1**	**Site2**	**Site3**	**Type of land holding 1**	**Site 1**	**Site2**	**Site3**
One hectare	31.6	18.5	14.7	Cultivated	100	100	94.1
More than one hectare	0	0	5.9	None	0	0	5.9
Less than one hectare	68.4	81.5	79.4	Total	100.0	100.0	100.0
Total	100	100	100				

None =no response, 0=no response

2.6 Land holding2 (irrigated or non-irrigated land) and Use of uncultivated land

Sub watersheds primary objective was to control soil and water loss whereas secondary objective was to provide irrigation facility. Results indicated that Irrigated land was maximum in site3 with 88.2% respondents while minimum respondents in site 2 with the 11.1%. However, none irrigated land was observed maximum in site 2 with 88.9% respondents while minimum in site 3 with the 5.9%(Table 6).Chourasia *et al.,* (2013) examined the impact of an integrated watershed project on bio-physical, socio-economic, environmental and ecological parameters in Bundi, Eastern Rajasthan. Chi square result shows that null hypothesis ($2H_0$ A) was accepted at 5 % (0.000) level of significance for all selected sites and type of land holding2. It shows that there was no significant relationship between sites and type of land holding 2 i.e., irrigation (Table8).

Use of uncultivated land results shows that Land grazing was observed maximum in site 2. Plantation in uncultivated land was observed only in site2 with the 15.8%. Response for fallow land was found maximum in site 2with the 44.4% frequency percentage. Response for none option was observed maximum in site3 with the 97.1 %(Table6). Chi square result of present study shows that null hypothesis ($2H_0$ A) was rejected at 5 % (.000) level of significance for site 1, and site 2 and use of no cultivated land. It shows that there was some significant relationship between site1, site2 and use of no cultivated land whereas it was accepted at 5 % (0.000) level of significance for site 3 and use of no cultivated land. It shows that there was no significant relationship between site 3 and use of no cultivated land (Table 8).

Table 6: **Frequency percent of type of land holding2 and use of uncultivated land at Pandoga sub watershed catchment area**

Type of land holding2/ irrigation method	**Site 1**	**Site2**	**Site3**	**Use of uncultivated land**	**Site 1**	**Site2**	**Site3**
Irrigated	15.8	11.1	88.2	Land grazing	15.8	22.2	0
Un irrigated	84.2	88.9	5.9	Plantation	15.8	0	0
				Fallow	36.8	44.4	2.9
Total	100.0	100.0	100.0	None	31.6	33.3	97.1
				Total	100	100.0	100.

							0

0=no response

2.7Source of irrigation and irrigation method

Irrigation level in area was an important indicator to judge the water storage facilities prevailed in area. Pipelines facilities were missing from Pandoga sub watershed to catchment area either for domestic purpose or for irrigation. But stored water in watershed was used only in dry period for live stocks. Respondents used only bore wells and open wells for irrigation. Maximum Irrigation through the bore well was in site3 with the 61.8% respondents while minimum irrigation was in site 2 with 14.8% respondents through bore wells. However other methods used are in minimum operation. Irrigation through open channel was observed maximum in site 3 with the 88.2% respondents (Table7 and Fig.4A-C). Water storage improved the ground water which could be accessed through bore wells in area particularly in site 3 which might be due to ground water recharge in lower stream of Pandoga sub watershed by gravity gradient.

Chi square result shows that null hypothesis ($2H_0$ A) was accepted at 5 % (0.000) level of significance for site1 and site2 and source of irrigation, type of irrigation. It shows that there was no significant relationship between site 1 and site 2 and source of irrigation, type of irrigation while Chi square result for site3 and source of irrigation, type of irrigation shows that null hypothesis ($2H_0$ A) was rejected at 5 % (0.000) level of significance. It shows that there was some significant relationship between site 3 and source of irrigation, type of irrigation (Table 8**).**

Table7: **Frequency percent of source of irrigation and irrigation method at Pandoga sub watershed catchment area**

Source of irrigation	Site 1	Site2	Site3	Irrigation method	Site 1	Site2	Site3
Open wells	0	0	8.8	Open channels	11.1	11.1	88.2
Bore wells	31.6	14.8	61.8				
None	0	85.2	29.4	None	88.9	88.9	11.8
Total	100.0	100.0	100.0	Total	100.0	100.0	100.0

0=no response

Table8: Chi square between type of land holdings, Use of uncultivated land, Source of irrigation and irrigation method with the sites at Pandoga sub watershed catchment area

Type of Land holding	Site 1	Site2	Site3
Land holding	ns	ns	Ns
Type of land holding 1	ns	ns	Ns
Type of land holding 2	ns	ns	Ns
Use of uncultivated land	*	*	ns
Source of irrigation	ns	ns	*
Irrigation method	ns	ns	*

ns=non significant,*=significant

2.8Cropping pattern

The choice and combination of crops to be grown by the cultivators depends upon several factors like geo morphological and economic factors. The study will be important to know the extent and proportion of area devoted to different crops. Wheat (CP) was grown in all sites with 100% frequency percentage respondent's response while kharif crop i.e., maximum maize crop (CP1) was grown in site 2 with 100% while minimum was observed in site3 (Table10). Maize in Kharif and wheat in Rabi seasons were the most important crops grown by the farmers in both the periods. However, cropping pattern show that maximum percentage of other crop (CP2) was found in site3 with the 85.3% for other crop i.e. potato crop while response by respondents of site2 with the 0 %(Table9). Cropping pattern gets shifted from traditional cropping to cash cropping due to water availability. Moreover, the development in the farm technologies and growth promoting inputs such as use of improved seeds, chemical fertilizers, pesticides/ herbicides and system of multiple cropping patterns brought drastic changes in the cropping pattern on farms. Change in cropping pattern was also observed (Wani *et al*., 2011; Wani and Pathak 2003) indicated that farmers invested in other productivity enhancement with the increased water availability.

Chi square result shows that null hypothesis ($2H_0$ A) was accepted at 5 % (.000) level of significance for site1, site2, site3 and cropping pattern. It shows that there was no significant relationship between site 1 and site 2, site3 and cropping pattern. Chi square result (Table12) shows that null hypothesis ($2H_0$ A) was accepted at 5 % (.000) level of significance for site 1, site2. It shows that there was no significant relationship between site 1 and site 2 but was rejected for site 3 and cropping pattern 1 that shows there was some significant relationship between site3 cropping pattern1. Chi square result shows that null hypothesis ($2H_0$ A) was accepted

at 5 % (0.000) level of significance for site2, site3 and cropping pattern2 that shows there was no significant relationship between site 2 and site 3 and cropping pattern2.Whereas null hypothesis was accepted for site 1 and cropping pattern2 .It shows there was some significant relationship between site 1 and cropping pattern 2(Table 12).

Table9: **Frequency percent of source of irrigation at Pandoga sub watershed catchment area**

CP	Site 1	Site2	Site3	CP 1	Site 1	Site2	Site 3	CP 2	Site 1	Site2	Site3
Rabi	100	100	100	**Kharif**	89.5	100.0	67.6	**Other**	21.1	0	85.3
None	0	0	0	**None**	10.5	0	32.4	**None**	78.9	100.0	14.7

CP: cropping pattern

2.9Farming management

Farming management tells how much modern technology was adopted and awareness of the respondents about new innovations in farming technology. Results indicated that mechanized farming was adopted by maximum respondents of site 3 with 88.2%frequency percentage. However, traditional method of farming was preferred by the respondents of site 1 with the 57.9 % .Fertilizer as a way for farming was preferred by the site1 with the 100.0% respondents which were followed by the site3 and at last by site 3.Manure as a way of farming was preferred in site1 with 100.0% followed by site 2 and site 3 with the 85.2% and 82.4% respectively from site 1 to site3 (Table10). Farming management assessment in present study shows that farming facilities are not sufficient to store the crop and fodder and to combat the nature of climate. This area did not have any access to market to sell agricultural products or cold store to store vegetables. Farming management was also shown in (Fig.4D-F).

Chi square result table shows that null hypothesis ($2H_0$ A) was accepted at 5 % (0.000) level of significance for site1 and faming management, faming management1 and faming management2. It shows that there was no significant relationship between site 1 and faming management, faming management1 and faming management2. Chi square result shows that null hypothesis ($2H_0$ A) was rejected at 5 % (0.000) level of significance for site 2 an site3 and faming management, faming management1 and faming management2. It shows that there was some significant relationship between site 2, site3 and faming management, faming management1 and faming management2 (Table12). Naidu (2001) in his study on Vanjuvankal watershed of Andhra Pradesh noticed that, there was an increase in the double –cropped area in the watershed. The farmers had shifted towards commercial crops from traditional.

Table 10: **Frequency percent of farming management at Pandoga sub watershed catchment area**

Farming management	Site 1	Site 2	Site 3	Farming management 1	Site 1	Site 2	Site 3	Farming management 2	Site 1	Site 2	Site 3
Traditional	57.9	70.4	11.8	**Fertilizer**	100.0	66.7	91.2	**Manure**	100.0	85.2	82.4
Mechanized	42.1	29.6	88.2	**None**	0	29.66	8.8	**None**	0	14.8	11.6
Total	100	100	100	**Total**	100.0	100	100		100	100	100

2.10 Live stock

Livestock rearing was an age-old economy gaining and food security system in rural area. Livestock rearing was an integral part of farming and holds the complementary relationship with crop production because crop by-products provide fodder for livestock rearing and livestock in turn provide valuable farm yard manures (FYM) for crops and livestock products (milk, wool, meal, etc.) to farm families**.** frequency percentage results shows that site1 had highest(84.2%) respondents who reared buffaloes while minimum(29.4%) respondents in site3.Decreasing trend for live stock from site1 to site2 as well as to site3 was observed (Table11).Whereas goats are found maximum in site2 with 22.2 % respondents while minimum in site 3. Results show that goats were replaced by buffalo rearing due to availability of crop fodder and differential pattern of rearing in selected sites. Differential pattern of livestock rearing in sites might be access to grazing area as well as shift from rabi and kharif crops to potato cropping. Livestock may emerge as the major act of economy earning in rural rainfed agricultural area but fodder was the main obstacle to gain this purpose. Watershed inception in Pandoga village had positively contributed for providing food security to cattle. The fodder availability had increased due to water availability as well as due to increase in crops which indirectly increased the fodder for cattle as well as farming of fodder crops. Wani *et al.* (2011) indicated live stock increased after implementation of watershed in Indian semi arid tropics. Availability of water increased fodder. Livestock rearing was also shown in (Fig.4G-I). Chi square result shows that null hypothesis (appendix) was accepted at 5 % (.000) level of significance for site1 and site3 and type of live stock. .It shows that there was no significant relationship between sites and live stock. Chi square result table shows that null hypothesis ($2H_0$ A) was accepted at 5 % (0.000) level of significance for site2 and type of live stock. It shows that there was no significant relationship between site2 and live stock. Chi square result shows that null hypothesis ($2H_0$ A) was rejected at 5 % (0.000) level of significance

for site 1 and site 3and type of livestock 1. It shows that there was some significant relationship between site1 and site3 and livestock. Chi square result table shows that null hypothesis ($2H_0A$) was accepted at 5 % (0.000) level of significance for all sites and type of live stock1.It shows that there was no significant relationship between sites and live stock1(Table12).

Table11: **Frequency percent of source of live stock at Pandoga sub watershed catchment area**

Live stock	**Site 1**	**Site2**	**Site3**	**Live stock 1**	**Site 1**	**Site2**	**Site3**
Buffalos	84.2	63.0	29.4	**Goats**	0	22.2	5.9
None	15.8	37.0	70.6	**None**	100	77.8	94.1
Total	100	100.0	100.0	**Total**	100.0	100.0	100.0

None=no respondents

Table12: Chi square between cropping pattern, cropping pattern1, cropping pattern2, Farming management, Farming management1, Farming management2, live stock and live stock 1 with the sites at Pandoga sub watershed catchment area.

Site	**Site 1**	**Site2**	**Site3**
Cropping pattern	ns	ns	Ns
Cropping pattern 1	ns	ns	*
Cropping pattern2	*	ns	Ns
Farming management	ns	*	Ns
Farming management1	ns	*	*
Farming management2	ns	*	*
Live stock	*	ns	*
Live stock1	ns	ns	ns

ns=non significant,*=significant

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Appendix

Chi Square Hypothesis for Socio Economic Analysis

$1H_0$: There is no significant relationship between the socio parameters and sites

$1H_0$: (S)i – (Si)j

S = socio parameters

Si = Sites

i = 1, 2, 3
1=caste, 2 =education, 3 = type of house j = 1, 2
1 =Post monsoon season, 2 = Pre monsoon season
$2H_0$: There is no significant relationship between the physical parameters and sites for two different seasons
H_0: (E)i – (Si)j
E = Economic parameters
Si = Sites
i = 1, 2, 3
1=occupation, 2 = income per annum, 3 =landholdings j = 1, 2
1 =site1, 2=site2, site3

Fig.2; A,swan channelization to control floods and over flow the banks;B-C,crate wire check dams and check dams to save water and soil.

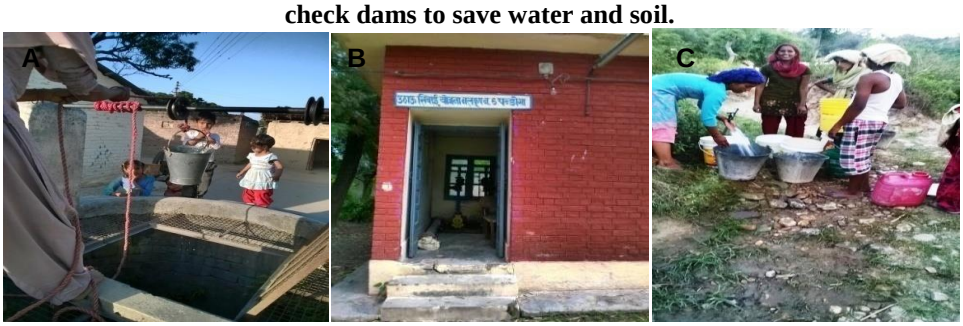

Fig.3: A-C, source of drinking water in pandoga sub watershed catchment area

Fig.4.:A-C, irrigation facility; D-F, Farming management ;G-I, Live stock of Pandoga sub watershed catchment area

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