



## Land Resource Inventory in Micro-Watershed Villages of Mahendragarh District, Haryana

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### ABSTRACT:

This paper attempts to study the details of land distribution, land holding size, pattern of irrigation, cropping pattern, agricultural productivity and other economic activities like livestock in the sample villages of selected micro-watersheds of Mahendragarh District.

### Introduction:

Haryana is predominantly an agricultural economy with preponderance of wheat, rice, bajra, mustard, sugarcane and cotton. In the recent years, commercial orientation of the state agriculture is more associated with mustard, vegetables, fruits etc. and the area under pluses has declined considerably. Management of natural resources at watershed scale produces multiple benefits in terms of increasing food production, improving livelihoods, protecting environment, addressing gender and equity issues along with biodiversity concerns (Wani et al., 2001; Sharma, 2002 and Joshi et al., 2005). There has been a significant change in the cropping pattern in Mahendragarh with introduction of irrigation. The parameters of physical environment as well as prevailing social, demographic and economic conditions make the district a fit case for adopting watershed management approach for planning and development.

### Study Area:

Mahendragarh district, the study area is situated in south-western part of Haryana, has a geographical area of 1927.8 km<sup>2</sup> comprising 4.36 percent of the state. It stretches between 27° 28' to 28°28' North latitude and 75° 54' to 75° 22' East longitude.

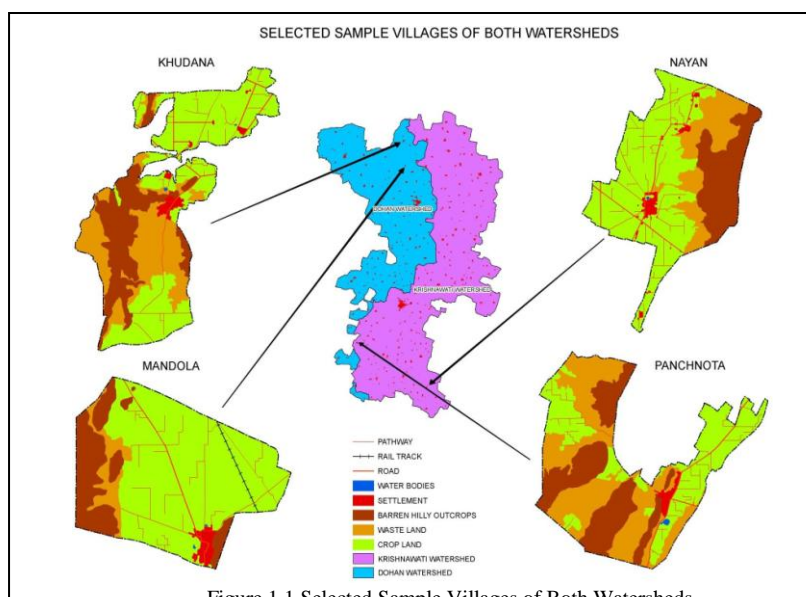


Figure 1.1 Selected Sample Villages of Both Watersheds

The district is part of Yamuna basin, as per Soil and Landuse Survey (GoI, 1988) and this district comprises two watersheds of two seasonal rivers i.e. Krishnawati and Dohan Rivers. Mahendergarh represents extreme arid to semi-arid climate, slight sloping to undulating plains and substantial rainfed cropland. These conditions necessitate for devoting higher acreages to low water consuming crops like mustard, bajra, barley and gram (Ramphul, 2012).

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### Objectives:

In this context, this study attempt to achieve following objectives:

- 1) To evaluate the present status of land resources in selected micro-watersheds
- 2) To evaluate the other economic activities like livestock in the sample villages

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### Methodology:

In order to achieve the objective, field survey was conducted during 2012. For the primary survey, four villages were chosen in the selected micro-watersheds which has been discussed in sample design. The selected villages are Nayan and Panchnota in Krishnawati watershed and Khudana and Mandola in Dohan watershed. As discussed in sample design, a total of 347 households were surveyed which were chosen on the basis of stratified random sampling technique. The social status of the households has been considered in terms of caste affiliation, as caste still represent the social structure of the society in rural areas and which is hierarchical. The castes were grouped into three categories based on the scale of social hierarchy i.e. (i) upper and dominant, (ii) intermediary and artisan and (iii) lower caste group. It may be noted that upper and dominant caste group here includes the caste of Brahmins, Baniya, Rajput, Gujjar and Ahir (Yadav). In Intermediary caste group- Kumhar, Khati, Jogi and Nai were included; while among lower caste group- Chamar, Dhanak, Kanjar and Lakhera are included. The economic status of the households has been derived by classifying the households on the basis of ownership holding of land. Economic status has been grouped into five categories. These are: (i) landless (having no land), (ii) marginal farmers (having less than 2.5 acre land), (iii) small farmers (land ranges from 2.5 to 5 acres), (iv) medium farmers (having land 5 to 10 acres), and (v) large farmers (having more than 10 acres of land).

The land status of the sample households has been measured by taking a number of indicators related to cropping pattern, percent irrigated area, irrigation intensity, cropping intensity and other livestock measures such as yield of bovines etc. have been measured by using the following formula:

- (i) Irrigation Intensity =  $\text{Gross Area Irrigated} / \text{Net Area Irrigated} \times 100$
- (ii) Percentage of GAI under all crops in GCA =  $\text{Gross Area Irrigated} / \text{Gross cropped Irrigated} \times 100$
- (iii) Average yield =  $\text{Total Production (Kg)} / \text{Area under crop}$
- (iv) Agricultural productivity =  $\text{Total output (Rs)} / \text{Net sown area}$
- (v) Cropping intensity =  $\text{Gross cropped area} / \text{Net sown area} \times 100$

Average yield of each bovine = Milk yields per day of the animal at peak in litres.

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### Data Base and Sample Design:

This paper is based on primary sources of data. It was collected through field survey. For this, a multi-stage sample was designed. At first stage, micro-watersheds were delineated in both the watersheds of Krishnawati and Dohan rivers falling in Mahendergarh district. At second stage, two micro-watersheds from each of these watersheds were selected. These micro-watersheds were chosen by taking into account the watershed programmes i.e. only those micro-watersheds were chosen where government programmes were initiated. At third stage, villages were selected. In all, four villages from four micro-watersheds were selected. The selected micro-watersheds and villages are shown in Figure 1.1.

In order to evaluate the watershed programmes in these selected villages, households were selected through a stratified random sampling technique. In all, 347 households from all villages were surveyed.

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### Results and Discussion:

#### *Distribution of Land and Size of Land Holding in Sample Villages:*

Land is the fundamental means of production in an agrarian society without which no agricultural production can take place. An understanding of the pattern of ownership and operational holdings of land is, therefore, of central importance to an understanding of the agrarian class structure (Rawal, 2008). The distribution of land is unequal among different social groups in the sample villages which has been presented in Table 1.1. It has been noted that upper and dominant caste own most of the land, while the ownership of land remains very less among other caste groups. In case of present study, in all the selected villages, ownership of land varies among villages. In Dohan watershed, the selected villages have little variation in land ownership i.e. here about two third households owned land. In villages of Krishnawati watershed, land ownership shows variation. Here, among the selected households, only 50 percent owned land. Land ownership is quite skewed in all the villages which may correspond to the caste characteristics. The distribution of land vis a vis social characteristics of the households reveal that majority of upper and dominant caste group households owned

land. Among intermediary and artisan caste group, land ownership was restricted to about 20 to 27 percent households, while in case of lower caste group, it was 6 to 17 percent households who owned land. In case of all villages, about one households were landless with an exception of Panchnota villages, where about 50 percent households were landless.

Table 1.1 Distribution of Households vis-a-vis Socio-economic Status

Social group	Dohan watershed (No of households)		Krishnawati watershed (No. of households)	
	Khudana	Mandola	Nayan	Panchnota
Upper and dominant caste	62	47	66	50
Intermediary and artisan caste	5	10	22	6
Lower caste	33	17	14	15
<b>Total (No. of households)</b>	<b>100</b>	<b>74</b>	<b>102</b>	<b>71</b>
<b>Economic characteristics</b>				
Small and Marginal (up to 5.0 acres)	31 (31.00)	27 (36.49)	35 (34.31)	17 (23.94)
Medium (5-10 acres)	26 (26.00)	12 (16.22)	21 (20.59)	9 (12.68)
Large (More than 10 acres)	7 (7.00)	7 (9.46)	11 (10.78)	10 (14.08)
Landless	36 (36.00)	28 (37.84)	35 (34.31)	35 (49.30)
<b>Total</b>	<b>100</b>	<b>74</b>	<b>102</b>	<b>71</b>
<b>Household owned land</b>				
Upper and dominant caste	61 (98.39)	41 (87.23)	59 (89.39)	35 (70.00)
Intermediary and artisan caste	1 (20.00)	2 (20.00)	6 (27.27)	0 (0.00)
Lower caste	2 (6.06)	3 (17.65)	2 (14.29)	1 (6.67)
<b>Total</b>	<b>64 (64.00)</b>	<b>46 (62.16)</b>	<b>67 (65.69)</b>	<b>36 (50.70)</b>
<b>Average landholding size (Acre)</b>	<b>5.61</b>	<b>5.26</b>	<b>5.82</b>	<b>8.31</b>
<b>Total owned land (Acre)</b>	<b>359.25</b>	<b>242</b>	<b>390</b>	<b>299.25</b>
<b>BPL households</b>	<b>22 (22.00)</b>	<b>17 (22.97)</b>	<b>12 (11.76)</b>	<b>21 (29.58)</b>

Note: Figures in the parentheses represent the percentage to the total

The statistics also reveals interesting facts in the distribution of land among different. In both the watersheds, only three castes namely, Rajput and Yadav (in Krishnawati watershed) and Gujjar (in Dohan watershed) are controlling major share of the total land. It is 92.73 percent in Dohan watershed and 91.26 percent in Krishnawati watershed. It may again noted that about 38 percent households in all the villages are landless. The average landholding size in 3 villages is 5 to 6 acres. In one village of Krishnawati watershed, the average landholding size is little large i.e. of 8.3 acre. Further, the land holding pattern in the Dohan watershed indicates that one-third land owners are small and marginal farmers, account for 33.33 percent followed by medium farmers which constitute 21.84 percent. The large farmers are only 8.05 percent of the total land holdings (Table 1.1). In Krishnawati watershed, the share of small farmers is again one-third followed by medium (17.34 percent) and large farmers (12.14 percent).

The proportion of socially disadvantaged groups such as lower and intermediary and artisan caste is higher among marginal and small farmers than that of medium and large farmers. The population of the both watersheds primarily depend on agriculture for livelihood as about 70 percent of the population is engaged in agriculture. Many studies show small farmers have limited access to new technology and their yield is often smaller than that of medium to large scale farmers. On the other hand, they make more effective use of their labour, and this may reverse the situation (Bhalla and Chadha 1982). Small and marginal farmers who are the backbone of rainfed farming watershed are resource poor and risk adverse and often small scale farmers adopt an integrated crop and livestock system (CRIDA, 2011). It is true that small holdings have higher productivity than medium and large farms because the households who own the smallest size of land employ more labour per unit of cultivated land than those with the larger scale. In both watersheds, the pattern of cropping, production and productivity vis a vis land size is discussed in following section.

#### ***Irrigation Pattern in Dohan and Krishnawati Watershed:***

As discussed earlier, both the watersheds in the study area falls in semi-arid climatic condition with limited rainfall of 598.73 mm. The rainfall in the district increases from the southwest towards the northeast. There are no perennial rivers running through the district, and about two-thirds of the area is

underlain in brackish water. Overexploitation of groundwater resources is occurring in the district as evidenced by the decline in groundwater levels, particularly in the north-eastern part of district. Irrigation from groundwater plays an increasingly critical role in farm sector. Currently, the percent irrigated cultivation in total cultivated area is about 56 percent which is one of the lowest in Haryana. That's why Ministry of Rural Development and Ministry of Agriculture adopted watershed programme to increase agricultural productivity in areas which are rainfed and cannot access any surface irrigation scheme.

In Mahendergarh, out of 194.160 thousand hectares of the cultivable area, 122.973 thousand hectares is under irrigation, which is about 63 percent. Further source wise irrigation suggests that only 1.27 percent is under canal irrigation and remaining area (98.73 percent) is under tube well irrigation or sprinkler irrigation, Comprehensive District Agriculture Plan (C-DAP), Mahendergarh. Well (including tubewells) is an important source of irrigation throughout Mahendergarh.

Table 1.2 presents percent irrigated area and irrigation intensity in the sample villages. It shows that about 60 to 70 percent area is under irrigation. Percent irrigated area is a little higher in Dohan watershed as compared to Krishnawati. Similarly, irrigation intensity in the sample study area ranges from 126 to 143 percent, with highest in Mandola village of Dohan watershed.

Table 1.2 Irrigated Area and Irrigation Intensity in Sample Villages

Sample villages	Percent area irrigated	Irrigation intensity
Khudana	60.83	126.28
Mandola	71.05	143.27
Nayan	63.54	134.44
Panchnota	65.59	138.67

The pattern of irrigation vis-à-vis size of landholding in sample villages has been presented in Table 1.3. It shows a clear correspondence of irrigated area with that of farm size meaning thereby that the access to irrigation is more in case of large farmers than all other farmers. This may be the reason for high irrigation intensity in Krishnawati watershed as here large farmer are more numerous as compared to other villages, while is evident from table 1.3 also. On the other hand, Small farmer has much less area under cultivation, hence, the results points out low access of tubewell irrigation. It may, however, be noted that large farmers capitalize on cheaper sources like own well while small farmers have to rent water. Cropping intensity, the number of crops planted annually, can be used as a measure of food security and it can greatly affect net production. The table however, shows almost same cropping intensity (200.00 percent) across all size of land holdings or farmers in both watersheds. In semi-arid area where limited assess of irrigation affects cropping intensity, there is no big difference in cropping pattern also.

Table 1.3 Irrigation Pattern in Dohan and Krishnawati Watershed

Land holding Size	all (up to 5.0acres)		Medium (5-10acres)		arge (More than10 acres)		Total	
	Dohan	Krishnawati	Dohan	Krishnawati	Dohan	Krishnawati	Dohan	Krishnawati
Irrigation Intensity	125.61	110.88	126.29	113.66	144.78	152.72	133.36	136.21
Percentage of GAI under all crops in GCA	61.53	48.86	62.27	56.13	69.67	72.24	65.02	64.40
Cropping intensity	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00

#### ***Cropping Pattern, Production and Productivity:***

The cropping pattern of the sample villages has been presented in Table 1.4. It has been derived from percent cropped area devoted to crops. In both the watersheds, pearl millet (Bajra) is a major kharif crop. It occupies 67.19 percent of net sown area in Krishnawati watershed, while in Dohan watershed it is 52 percent. For rabi season, mustard is major crop. It occupies half of net sown area in all the villages of both sub-watersheds. Wheat is another major crop followed by mustard. It may be noted that gram occupies one-fifth of net sown area, while one-sixth area is devoted to this crop in Dohan watershed (Table 1.4).

Table 1.4 Area under each Crop in Sample Villages (Area in acres)

Crops	Dohan watershed			Krishnawati watershed		
	Khudana	Mandola	Total	Nayan	Panchnota	Total
Wheat	127	83	210 (34.34)	138.5	71	209.5 (31.32)
Mustard	187.5	119	306.5 (50.12)	193.5	123	316.5 (47.31)
Gram	53	44	97 (15.86)	59	84	143 (21.38)
Pearl millet	206.5	113	319.5 (52.25)	213.5	236	449.5 (67.19)
Guar	147	126	273 (44.64)	171.5	42	213.5 (31.91)
Other crops	4	7	11 (1.80)	6	0	6 (0.90)
Gross cropped area	725	492	1217	782	556	1338

Note: Figures in the parentheses represent the percentage to the net sown area.

Table 1.5 shows the village wise yield of different crops. The yield of crops shows variation in different villages. The highest yield of wheat is in Mandola followed by Nayan and Khudana villages. It may be noted that Panchnota village of Krishnawati watershed reports comparatively very low yield of wheat. There is slight difference in mustard yield in all sample villages. Highest yield of pearl millet found in villages of Krishnawati watershed. Over all the performance of Panchnota village is low as compared to other villages.

Table 1.5 Crop wise Average Yield in Sample Villages (in kg per acre)

Crop wise	Dohan watershed		Krishnawati watershed	
	Khudana	Mandola	Nayan	Panchnota
Wheat	1906	1955	1937	1778
Mustard	796	807	808	804
Gram	629	690	742	655
Pearl millet	768	753	831	776
Guar	388	442	386	363
Other crops	750	750	700	0

As regards to the yield of wheat, Haryana stands first (2036.44 Kg per acre) according to 2011-12 (GoI, 2013). This not only is the superior grain of Mahendergarh but also a large proportion is sown with the aim of selling. Dohan watershed is much ahead in yield of wheat in comparison Krishnawati watershed i.e. 1928 instead of 1894 kg per acre, while the average yield of wheat in both watersheds are low to the state average and high to the national average. The yield of wheat crop vis-à-vis size of land holding is presented in Table 1.6. It may be noted that yield of wheat is better among small farmers as compared to medium and large farmers in both the watersheds. Same pattern may be obtained from productivity.

Rapeseed-mustard is the major source of income especially even to the large and medium farmers in semi-arid areas. Since this crop is cultivated mainly in the semi-arid and resource scarce regions of the state, their contribution to livelihood security of the large and medium farmers in these regions is also very important. Table 1.6 shows small farms has highest yield of mustard seed in both the watersheds followed by medium and large farmers. Almost same yield found in both watersheds. Mustard is mostly sown by large and medium farmers because small farms have the size of landholding are so small so that they want self- sufficiency in grains. In Mahendergarh, mustard crops is gaining wide acceptance among the farmers because of adaptability for both irrigated as well as rainfed and suitability for sole as well as mixed cropping. Among the oilseed crops, the area under mustard is increasing and also substantially grown as intercrops with wheat, while that of superior cereal like wheat is on decline. Average productivity is higher in villages of Dohan watershed as compared to villages of Krishnawati watershed.

Table 1.6 Crop wise Area, Yield and Productivity among Different Land Holding Size in Sample Villages: 2012

Crops		Dohan watershed			Krishnawati watershed			All cultivators	
		Small	Medium	Large	Small	Medium	Large	Dohan	Krishnawati
Wheat	Yield (Acres)	1931	1924	1929	1940	1857	1840	1928	1894
	Productivity (Rs)	24792	24810	24802	25016	24181	22898	24801	23719
Mustard	Yield (Acres)	852	797	707	844	812	767	800	806
	Productivity (Rs)	25458	23902	21977	25619	24172	22197	23360	23081
Gram	Yield (Acres)	583	675	660	653	692	764	652	697
	Productivity (Rs)	21830	23408	24342	24752	25311	25371	23611	25227
Pearlmillet	Yield (Acres)	789	762	657	860	790	733	762	812
	Productivity (Rs)	6271	6000	5412	6989	6306	5549	5828	5976
Guar	Yield (Acres)	428	397	414	360	391	393	411	383
	Productivity (Rs)	34327	32067	33897	28958	32110	29714	33181	30407
Othercrops	Yield (Acres)	0	0	750	0	0	700	750	700
	Productivity (Rs)	0	0	29455	0	0	28000	29455	28000
<b>Productivity</b>		<b>42248</b>	<b>43915</b>	<b>40580</b>	<b>38885</b>	<b>41531</b>	<b>35588</b>	<b>42174</b>	<b>37709</b>

Gram is one of the important pulses grown in rabi season. The districts of Bhiwani and Mahendergarh are the core of the gram cultivation region of the state (Rampal, 2012). Sample villages represent extreme arid to semi-arid climate, slight sloping to undulating plains and substantial rainfed crop land. These conditions necessitate for devoting higher acreages to low water consuming crops like gram. Mahendergarh is the second largest producers of gram in the state. It accounts for 15.86 percent in Dohan watershed and 21.38 percent in Krishnawati watershed of the total area under rabi during the current year. This crop was extensively grown in un-irrigated areas of sample villages. Table 1.6 reveals that yield under medium farmer was high that is 675 kg per acre as compared to large and small farmer which is 660 and 558 kg per acre, respectively in Dohan watershed. While in Krishnawati highest yield found in large farmer followed by medium and small farmers. Small farmers are sown in less amount of land because of short land availability and low productivity of gram crop. Wheat profitability has remained low in comparison with gram because low-input crop like gram may stand competitive against rest of the leading wheat crop. Gram cultivated areas are mostly un-irrigated or undulating areas of both watersheds and basically found in large farmer (Table 1.6). After that the production and area under this crop is shrinking continuously. Literature reveals that the cropping pattern of Mahendergarh district has shifted towards mustard. Gram crop is marginalised in the irrigated areas of the district because people prefer high yielding and more remunerative crops like mustard, although gram is still grown in both watersheds.

Mahendergarh happens to be an important pearl millet growing district, but since the 1990s, guar has replaced pearl millet. Now pearl millet accounts for only 52.25 and 67.19 percent of the total area under kharif crop in the sample villages of Dohan and Krishnawati watershed, respectively (Table 1.4). The crop ranks second among the food and non-food crops after wheat. Highest yield is found in Krishnawati as compared to Dohan watershed i.e. 812 kg per acre in comparison of 762 kg per acre. It is observed that average yield of pearl millet crop in both watersheds is highest among small farmer followed by medium and large farmer. Bajra is broadly harvested in all land size cultivators. In Krishnawati watershed, bajra crop remains a dominant cereal crop in kharif season, it fulfils the need of grain as well as fodder to the livestock. It is considered as a nutritious and heat giving food during winter. Pearl millet stover is a valuable livestock feed in both the watersheds. In Dohan watershed, the matured crop is unirrigated, and watering area is only 5 percent of the bajra harvested area. In Krishnawati, its productivity is much higher in all land size categories (Table 1.6).

In Haryana, the average yield of guar in 2011-12 was estimated at 546.56 kg per acre while the national average of guar seed is 260.73 kg per acre only (Department of Agriculture, Haryana 2013). The area, production and yield of this particular crop is inconsistent due to its overdependence on monsoon and production is confined to limited geographical area largely arid regions. Table 1.6 reveals that in Dohan watershed, the yield has been estimated high among small farms followed by medium and large. While in Krishnawati watershed, the maximum yield is obtained by the large farmer followed by medium farmers with small landholdings. Productivity wise Dohan is better than Krishnawati watershed in all land holding categories. Guar is the highest output commodity in kharif season. A low input crop like guar may stand competitive against rest of the leading kharif crops even at low yield, largely due to its better market prices. As guar beans can be stored for 3 to 6 years and due to almost no fertilizer inputs and limited disease infestation are the factors, which are encouraging farmers to adopt guar for improvement in productivity and profitability. However, in recent years the high prices of the crop have made it competitive and popular among all land size farmers. Literature suggests that higher profitability and also the resilience in

production, guar is replacing Bajra in Mahendergarh district.

Table 1.6 reveals that average yield of other crop is 750 and 700 kg per acre in Dohan and Krishnawati watershed respectively. In other crop mainly cotton and jawar are included. It may be noted that only 1.80 and 0.90 percent land has been put to these crops in Dohan and

Krishnawati watershed respectively. These crops are largely grown by large farmers. In Dohan watershed, these crops are showing better performance as compared to Krishnawati watershed villages. The light sandy soil and limited irrigational facilities in sample villages restrict the cotton cultivation. Moreover, soil suitability of crops do reveal that area is not suitable for this crop.

Since land productivity in the sample villages is about Rs. 40000 per acre, livestock rearing is another major occupation through which people supplement their livelihood. In this context, the status of livestock in the sample study area has also been studied.

#### ***Livestock dependence and its structure in study area:***

It may be noted that 75 percent population and their economy in the state is based on agriculture. The livestock and especially bovines provide economic stability to the farmers in the face of uncertainties associated with the agricultural production in dry land or rainfed farming watershed. Livestock has a deep social and cultural importance also, as it fetches higher economic returns and best suited to the climatic condition of Haryana (Rana 2004; Chauhan and Jaglan, 2014). On an average 15 percent of household income in the state is derived from livestock production. For poor households, like landless and women, the importance of livestock production is much larger. Studies show that major part of the livestock population is concentrated in the marginal and small size of holdings (GoI. 2006).

The predominant farming system in almost both watersheds areas are the "mixed crop-livestock farming system" under rainfed condition. Most Watershed development programmes result in fallow lands, increasing the net sown area and therefore the additional fodder availability through crop residues, leading to a momentum in stall-feeding of dairy cattle (Pagire and Shinde 2000). The importance of animal husbandry in Mahendergarh is evident from the fact that most of the crops are semi-fodder type, which supplies grain for man and fodder for beasts.

The ownership and structure of bovine livestock in Dohan and Krishnawati watershed has been presented in Table 1.7. It reveals that near about 86 percent households own livestock. The most common livestock is buffaloes which are owned by 82 percent households in almost all villages. Cattles are owned by 19 percent households. It reveals that economic viability or secondary source of income as buffaloes are more productive and economic as compared to all other animals. In Krishnawati watershed, percentage of buffaloes owned households has been decreased from upper to lower caste while in Dohan, strength of buffaloes owned households found in upper and dominant followed by lower caste and intermediary caste and the same pattern followed by cows owned households in both watersheds. Literature suggests that there is shift from the cows to buffaloes in the state because the development of Murrah high yield producing breed of buffalo is given maximum profit to owner. During field work, the general impression gathered is that Gujjars look after their cattle well and cattle's trading is mainly conducted by them. Drought animal like Camels and Male buffalos are very rare found in sample villages that are 3 percent owned households in both watersheds. These animals are mainly found in upper and dominant caste in both of watersheds. Goats and Sheep owned households are 36.42 and 20.11 percent of the total households in Krishnawati and Dohan watershed, respectively and decreases from lower to upper and dominant caste group. Goats are more common, whereas sheep are few in quantity. Due to rainfed areas of state had a slight increase because of the availability of grazing lands, barren rocky outcrops and the least extension of irrigation. In Krishnawati watershed, the dominant Gujjars caste and lower caste rear herd of goat and sheep which are known as revad. One of the sample village Mandola (in Dohan watershed) have least population of goats and sheep because elsewhere the ratio declined in varying degree depending on the decreasing acreage of the pasture land related to the extending plain area and also goats breeding is suffering from the religious taboo, which is a hindrance in upper and dominant caste (Rajput and Ahir) but resource poor farmers (mostly in lower caste) of the sample villages, who cannot invest large sums of money in cattle and buffalo, prefer sheep and goat husbandry which has no social, religious or cultural taboos, or caste restrictions.

It may be noted that among large land holding cultivators, buffalo is owned by almost all households and its ownership decreases as the land holding reduces. Bovine ownership is quite less among landless in both the watersheds. This is largely because it is difficult for the landless households to keep she-buffaloes on account of their considerable requirement of fodder and concentrates for good milk yield. On the contrary, the ownership of cows are better among landless households in both watersheds (Table 1.7). Large percentage of goats and sheep ownership is visible among landless households in Krishnawati and Dohan watershed. Its ownership is quite less among large land holder. It is locally said that goat is a cow of the poor landless class and makes milk within his access at low cost.

Introduction of mechanization and commercialization in agriculture increased utility of livestock sector and it has changed the livestock scenario of Haryana. So the structure of bovine population rearing is transformed from subsistence to the commercial level (Chauhan and Jaglan, 2014). Table 1.8 presents the milk production and milk yield (peak time) of each bovine in Dohan and Krishnawati watershed. It may be noted that large bovine owners sell their milk as compared to milk product. Milk selling is 58.71 and 55.17 percent in Dohan and Krishnawati watershed villages, respectively. About 43 percent of the households having market their milk either directly to their neighbours, or sold to the local milkman. Goat milk is invariably for home consumption and if traded at all, it is mixed with cow or buffalo milk. In Dohan watershed, the intermediary and artisan caste households contributed the highest selling of milk (72.73 percent) followed by lower caste (61.36 percent) households. It may be noted that even 56 percent upper and dominant caste households also sold milk. The selling of milk product (mainly Ghee) was higher in lower caste group as it was necessary to supplement their income by this. Animal husbandry and selling milk is the traditional occupation of Gujjars and it continues to be their secondary occupation which is visible in Krishnawati watershed villages. In Dohan watershed, average yield of buffalo and cow is 9.22 and 6.50 litre per day at peak time in lactation (These estimates, however, were the milk yields/day of the animal in-milk on the day of the survey, in the households surveyed and as reported by the respondents). In Krishnawati it is 9.43 (Buffalo) and 5.84 (Cow) litres per day. Moreover highest milk yield was found in intermediary caste group in both watersheds. Goat rearing has no religious or cultural inhibitions in Krishnawati watershed and is reared by all caste groups.

Table 1.7 Livestock Ownership and Structure in Dohan and Krishnawati Watershed

Categories	Total number of households		Buffaloes		Cows		Goats and sheep		Others animals	
	Dohan watershed	Krishnawati watershed	Dohan watershed	Krishnawati watershed	Dohan watershed	Krishnawati watershed	Dohan watershed	Krishnawati watershed	Dohan watershed	Krishnawati watershed
Upper and dominant caste	109	116	101(92.66)	103 (88.79)	22 (20.18)	26 (22.41)	18 (16.51)	39 (33.62)	2 (1.83)	8 (6.90)
Intermediary and artisan caste	15	28	9 (60.00)	17 (60.71)	4 (26.67)	2 (7.14)	2 (13.33)	10 (35.71)	0 (0.00)	0 (0.00)
Lower caste	50	29	40 (80.00)	16 (55.17)	10 (20.00)	1 (3.45)	15 (30.00)	14 (48.28)	1 (2.00)	0 (0.00)
<b>Total</b>	<b>174</b>	<b>173</b>	<b>150 (86.21)</b>	<b>136 (78.61)</b>	<b>36 (20.69)</b>	<b>29 (16.76)</b>	<b>35 (20.11)</b>	<b>63 (36.42)</b>	<b>3 (1.72)</b>	<b>8 (4.62)</b>
Landless (No land)	64	70	46 (71.88)	41 (58.57)	13 (20.31)	12 (17.14)	15 (23.44)	24 (34.29)	1 (1.56)	0 (0.00)
Small and marginal (0-5 Acres)	58	52	55 (94.83)	46 (88.46)	12 (20.69)	9 (17.31)	9 (15.52)	19 (36.54)	0 (0.00)	1 (1.92)
Medium (5-10 Acres)	38	30	35 (92.11)	28 (93.33)	6 (15.79)	2 (6.67)	7 (18.42)	9 (30.00)	2 (5.26)	5 (16.67)
Large (Above 10 Acres)	14	21	14 (100.00)	21 (100.00)	5 (35.71)	6 (28.57)	4 (28.57)	11 (52.38)	0 (0.00)	2 (9.52)
<b>Total</b>	<b>174</b>	<b>173</b>	<b>150 (86.21)</b>	<b>136 (78.61)</b>	<b>36 (20.69)</b>	<b>29 (16.76)</b>	<b>35 (20.11)</b>	<b>63 (36.42)</b>	<b>3 (1.72)</b>	<b>8 (4.62)</b>



Note: Figures in the parentheses represent the percentage of total households own livestock under each category.

Table 1.8 Level of Commercialization of Dairy Farming in Dohan and Krishnawati Watershed

Categories	Total number of households own livestock		Number of households				Average yield at peak (in litres)					
			Selling milk		Selling milk product		Buffalo		Cow		Goat and Sheep	
	Dohan watershed	Krishnawati watershed	Dohan watershed	Krishnawati watershed	Dohan watershed	Krishnawati watershed	Dohan watershed	Krishnawati watershed	Dohan watershed	Krishnawati watershed	Dohan watershed	Krishnawati watershed
Upper and dominant caste	100	106	56 (56.00)	62 (58.49)	45 (45.00)	62 (58.49)	9.18	9.57	6.27	5.73	1.56	1.42
Intermediary and artisan	11	21	8 (72.73)	12 (57.14)	5 (45.45)	9 (42.86)	8.88	9.00	8.50	6.50	2.00	1.56
Lower caste	44	18	27 (61.36)	6 (33.33)	22 (50.00)	5 (27.78)	9.38	8.92	6.13	7.00	1.69	1.38
<b>Total</b>	<b>155</b>	<b>145</b>	<b>91 (58.71)</b>	<b>80 (55.17)</b>	<b>72 (46.45)</b>	<b>76 (52.41)</b>	<b>9.22</b>	<b>9.43</b>	<b>6.50</b>	<b>5.84</b>	<b>1.65</b>	<b>1.43</b>
Landless (No land)	53	48	33 (62.26)	24 (50.00)	27 (50.94)	20 (41.67)	9.42	9.25	6.62	5.36	1.77	1.45
Small and marginal (0-5)	54	48	27 (50.00)	25 (52.08)	19 (35.19)	25 (52.08)	8.61	9.45	6.58	6.33	1.57	1.50
Medium (5-10 Acres)	34	28	23 (67.65)	13 (46.43)	16 (47.06)	13 (46.43)	9.52	9.35	6.33	5.00	1.57	1.22
Large (Above 10 Acres)	14	21	8 (57.14)	18 (85.71)	10 (71.43)	18 (85.71)	10.21	9.73	6.00	6.50	1.50	1.45
<b>Total</b>	<b>155</b>	<b>145</b>	<b>91 (58.71)</b>	<b>80 (55.17)</b>	<b>72 (46.45)</b>	<b>76 (52.41)</b>	<b>9.22</b>	<b>9.43</b>	<b>6.50</b>	<b>5.84</b>	<b>1.65</b>	<b>1.43</b>

The selling of milk product is higher among large farmer in both of watersheds because they have large number of milch animal, as compared to medium and small farmers and landless households. Krishnawati watershed villages reveals tendency of milk selling and their product among large farmers as compared to Dohan watershed. The highest yield of buffaloes are found in large farmer in both watersheds. A large number of scheduled castes and landless households possess only one milch cattle which is procured through an arrangement under which a household takes a milch calf from a cattle-owning (usually large farmer) household for tending. When the calf grows up, the household that gave the calf and the household that tended it have an equal share in the value of the calf. Either one of them can buy the grown up cattle by paying the other household its share in the value of the cattle. This is the arrangement which is made by landless household to generate income. Landless and small farmer households in both watersheds depend on this activity for their livelihood.

## Conclusions:

The distribution of land resources and the analysis on land holding size reveals that about two-third sample households own land. Majority of upper caste households own land while it is the lower and intermediary caste groups, which are landless. The size of landholding in sample villages remain 5 to 6 acres per household. As far as irrigation infrastructure is concerned, two-third of land is irrigated. Irrigation facility is better among large farmers as compared to small and medium farmer households. It may however, be noted that irrigation intensity in sample villages and in both watersheds is much better than district average, however, in comparison to Haryana, this is rather low.

In both the watersheds, pearl millet (Bajra) in kharif and mustard in rabi seasons are major crops and occupies half of net sown area in respective season in all the villages of both watersheds. The yield of crops shows correspondence with size of landholding indicating higher yield among small farmers. Mustard is mostly sown by large and medium farmers. As it is a low productive crop pearl millet is broadly harvested in all land size farmer. As far as productivity is concerned, Dohan watershed shows better performance than Krishnawati watershed.

Both the watersheds have adopted "mixed crop-livestock farming system" which is a norm under rainfed condition. Results reveal that about 86 percent households own livestock. The most common livestock is buffaloes which are owned by 82 percent households in almost all villages. The economic

viability or secondary source of income as buffaloes is more productive and economic as compared to all other animals. Almost all large farmers have buffaloes and its ownership decrease with respect to economic status of households in both the watersheds. Large percentage of goats and sheep, ownership is found among landless households in Krishnawati and Dohan watershed. It may be noted that livestock rearing adds to household economy in sample villages. The selling of milk product is common among large farmers and upper and dominant caste households in both of watersheds.

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