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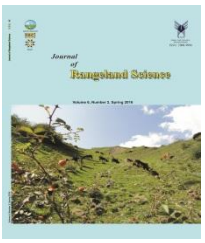

Research and Full Length Article:

Study the Role of Natural Capitals on Villagers' Dependence on Rangeland (Case Study: HableRud Basin in Iran)

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Abstract. FAO and World Bank promote livestock rearing as a way of poverty alleviation and food security especially among rural poor. Villagers are usually involved in mixed crop-livestock farming. Interviews with villagers in the HableRud basin revealed that some changes have happened and comparing with past decades, fewer villagers keep livestock. They believed that number of villagers who kept livestock in pen has also drastically increased. This study was conducted to understand if natural capital holdings have any impact on villagers' dependence on rangeland or not and also to identify the important natural capitals contributing to villagers' dependency on rangeland, some unstructured and structured interviews with local people were conducted. Comparisons between the two groups of villagers namely, dependent and independent on rangeland in terms of the identified indicators, the independent samples T-test and Mann Whitney U were applied for parametric and nonparametric data, respectively. Then in order to predict likelihood of dependency of a villager on rangeland based on holding of or access to independent variables, binary logistic regression was applied using SPSS. Descriptive data analysis showed that just 177 villagers out of 380 samples were dependent on rangeland and the rest did not rely on rangeland at all. The results revealed that there was a significant difference between the two groups of dependent and independent villagers on rangelands in terms of grazing right, size of farm and orchard holding, number of small livestock, total livestock and total natural capital. But the best indicators to predict a villager's dependence on rangeland was decided to be grazing right, number of small livestock and size of farm. The study revealed that independent variables predict the odds (61% - 82%) that a villager will decide to keep livestock dependent on rangeland.

Key words: Livestock, Dependency, Farm, Orchard, HableRud

Introduction

There is an estimated 500 million family farms. Family farming is the most common agricultural system in the world. Family farms represent approximately 1.4 billion people, and 96% of family farms are located in southern countries (FAO, 2001; Ferraton and Touzard, 2009) and they supply more than 70% of the local and regional food market, contributing significantly to food security at the local, national and regional level (Anonymous, 2009). Rural households often combine a number of livelihood activities to meet subsistence needs, such as agricultural crop production, wage labor, or forest product collection. Of course, villagers' access to different livelihood capitals and opportunities will shape the potential mix of activities (Ellis, 1998; Bryceson, 2002).

The natural capital concept was popularized in the early 1990s and was born out of theoretical advances to bridge the gaps between economics and ecology (Voora and Venema, 2008). In the 'capital approach', the traditional definition of capital as manufactured factors of production, such as machinery and roads, is extended to include further capital types, like human, social and natural capital (Neumayer, 2003). In this paper natural capital is used as one of the 5 capitals of Sustainable Livelihoods (SL) framework. The SL framework is well suited to examining population-environment interactions (De Sherbinin *et al.*, 2008; Massey *et al.*, 2010), since population dynamics (e.g., migration) are often reciprocally related to livelihood strategies, which are themselves directly or indirectly affected by local environments.

The access to and ownership of natural economic capital such as land and livestock increases a household's capability to continue farming and thus, reduce the likelihood of farm exit. The variations in family farm activities are mainly due to variations in the size of the farm holding, in the size of the herd, and in the share of farmland owned by the farm household (Rueff and Gibon, 2010). In Canada, Kimhi and Bollman (1999) found a lower tendency to exit if farmers operated mixed farms with crops and livestock. Moreover, animals are also used as economic capital. Researchers have shown that in the Sahel, crop producers are increasingly keeping livestock and herders increasingly engage in crop cultivation (Toulmin, 1983; Pelissier, 1977).

Bourn and Wint (1994) also showed that with a general movement of livestock from northern to southern regions of the Sahel, an initial coexistence has been followed by a gradual integration of animal husbandry within local farming systems' (see also Delgado, 1989). Western Europe has been experiencing the intensification, separation and specialization of agricultural and livestock systems since the middle of the twentieth century (Kirkegaard *et al.*, 2011). Kisamba-Mugerwa (1992) stated that pastoralists in Uganda also resorted to cultivation to supplement livestock products, thereby pushing cropping to marginal land.

North America has followed a similar trend where, in places like Iowa, farms have become increasingly specialized grain or livestock producers since the 1950s (Brown and Schulte 2011). Until recently, Australia did not follow this trajectory. Farmers traditionally retained a mix of cropping and livestock enterprises ('mixed farming') as a risk management strategy that gave them the flexibility to respond to climate and market variations as stated by Ellis (2000) for risk spreading. However, in the past two decades, Australia has begun to see a shift. In the rangelands and semi-arid regions where livestock has always dominated, mixed farming continues, but in the higher rainfall areas of the eastern and western wheat/sheep belts, there has already been a swing away from

traditional mixed crop-livestock systems towards either crop or livestock systems. From 1992-93 to 2009-10, the area planted to crops (excluding pastures and grasses, and hay) increased by 50%, while grazing area decreased by 6% (Lesslie *et al*., 2011).

The available literature suggests that there is a strong relationship between access to natural capital and involvement in agricultural activities including livestock keeping. In this study, researchers were interested to study if access to natural capital i.e. the right to graze on rangelands, size of farm and orchard holding, number of small and big livestock can play any role in deciding to keep or leave livestock or feed them on rangeland or in pen. HableRud basin was selected because villagers who still raise livestock either on rangeland or in pen and also those who have left livestock keeping, could easily be found and villagers believed that in the near future, more people will leave livestock keeping.

Materials and Methods

Study area

The study was conducted in HableRud basin. The basin locates in northern Iran, between Tehran and Semnan provinces with an area of 1.26 m ha (Fig. 1). The human population in rural areas including villagers and mobile pastoralists is 70,221 and 86,947 people live in urban areas summing 157,168 people living in 6 townships. The relative density of population of the basin is 12 people per km^2, comparing with the national figure of 43 people per km^2 indicates low population density of the basin. Based on the census, family size of rural areas was 3.6 in 2006. It was also less than the figure of 3.7 in the urban areas of the basin and the national figure of 4. In northern part of the basin, there are 29,958 ha of farmlands comprised of 77.4% of irrigated and 22.6% of rainfed and livestock rearing is also common in the northern part which is predominantly mountainous. In the southern part of the basin, there are 41,730 ha of farm and orchard, mainly irrigated. Some of the farmers of the southern part of the basin are transhumant herders who graze their livestock within both parts of the basin. The northern part of the basin enjoys semi-arid climate where the southern part enjoys arid climate. Some decades ago, when agricultural activities were very flourishing many people immigrated to the basin to work in agricultural activities and live there but recently, out migration is very common.

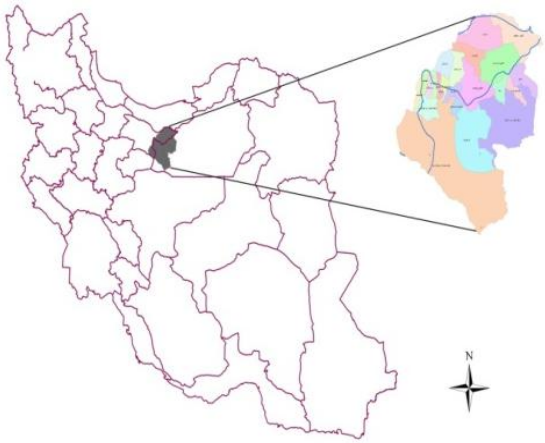

Fig. 1. HableRud basin location in Iran

Data collection

In order to conduct the study which required a filed survey, both desk study and interviews, structured and unstructured, were accomplished. Based on these surveys, grazing right, size of farm holding, size of orchard holding, size of farm and orchard holding, number of small livestock, number of big livestock, total number of livestock (equivalents calculated) and total natural capital were identified as the indicators to measure each rural family's natural capital. In fact, these indicators were independent variables and dependency on rangeland which meant having livestock grazing on rangeland was the dependent variable of this study.

During the interviews, ordinary farmers were asked to express their idea about how much of the identified

indicators can individually maintain their needs. Table 1 shows the minimum amount of natural capitals necessary to meet the needs of one ordinary rural family based on the interviews. To calculate each rural family's natural capital possession, it was assumed that minimum amount of each indicator to maintain a rural family to be 10 (Table 1). It was also assumed that maximum total amount of natural capital; one rural family can have, to be 10.

Table 1. Amount of natural capital to meet the needs of ordinary villager families

Indicator	Minimum Amount Needed	Score
Size of farm holding(ha)	3	10
Size of orchard holding(ha)	1.5	10
Small livestock holding (head)	250	10
Big livestock holding (head)	30	10

Each family's natural capital possession can be calculated by proportioning the amount they have, with the minimum amount to meet a family's needs. For example, if a family has 0.5 ha of farm and 0.5 ha of orchard and 50 small livestock and 2 cattle (big livestock), then total natural capital of this family will be 1.6 + 3.3 + 2 + 0.6= 7.5. As mentioned earlier, the maximum figure for each family's natural capital is 10.

To find the optimum sample size, Krejcie and Morgan (1970) Table was used as an easy reference. Since the study area was located between two provinces, so the samples were selected through cluster sampling. It is a variation of multi-stage sampling. In this method, total population was first divided into clusters of sampling units which was 2 provinces. Again divided into 2 townships namely Damavand and Firouzkouh in the north and Aradan and Eivanakey in the south, and then divided into 5 villages in each township. Thus, 380 samples were distributed among 2 provinces, 4 townships and 20 villages which meant 19 samples (families) per each village.

Almost all family heads were interviewed face to face and questionnaires filled. Based on the answer given to the critical question of "do you have livestock grazing on rangeland? They were grouped into dependent and independent on rangeland.

Statistical Methods

In order to identify whether there is any significant difference between population means of the two groups namely, dependent and independent villagers on rangeland, were compared using t-test. It was assumed equal variances. For nonparametric data, Mann Whitney U test was applied, which is almost the same as t-test.

In order to predict dependency of villagers (dependent variable) from natural capital indicators (independent variables), binary logistic regression was applied. Binary logistic regression model was applied to identify some of the factors that could determine whether a villager keeps livestock dependent on rangeland or not.

Thus, a binary logistic regression is appropriate when the dependent variable has two outcomes (Maddala, 1993). The Omnibus test shows how properly the model fits. The values in Cox and Snell R^2 and Nagelkerke R^2, can be interpreted like R^2 in a multiple regression were estimated. The values in model reveal that how independent variables can predict the odds that a villager will decide to keep livestock dependent on rangeland. The Hosmer-Lemeshow test was used for logistic regression to find out how well the model fits the data. All of statistical analyses were made using SPSS software.

Results

The first result of this study was that from 380 sample families, just 177 families equal to 46.5% were dependent on rangeland and the balances were independent. Note to mention that 111 families did not keep livestock at all. Descriptive analysis of the collected questionnaires revealed that families enjoyed a wide range of natural capital holdings. Each family had either all of the identified natural capitals or some of them as shown in Fig. 2. Analysis of the collected data revealed that there was a wide difference between villagers in terms of livestock keeping. Figs. 3 and 4 show frequency of villagers' small and big livestock holdings.

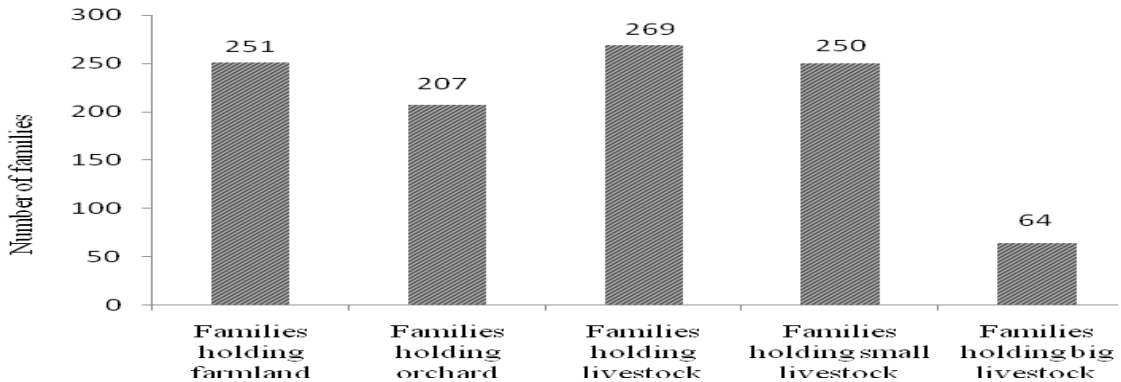

Fig. 2. Number of families with different natural capital holdings

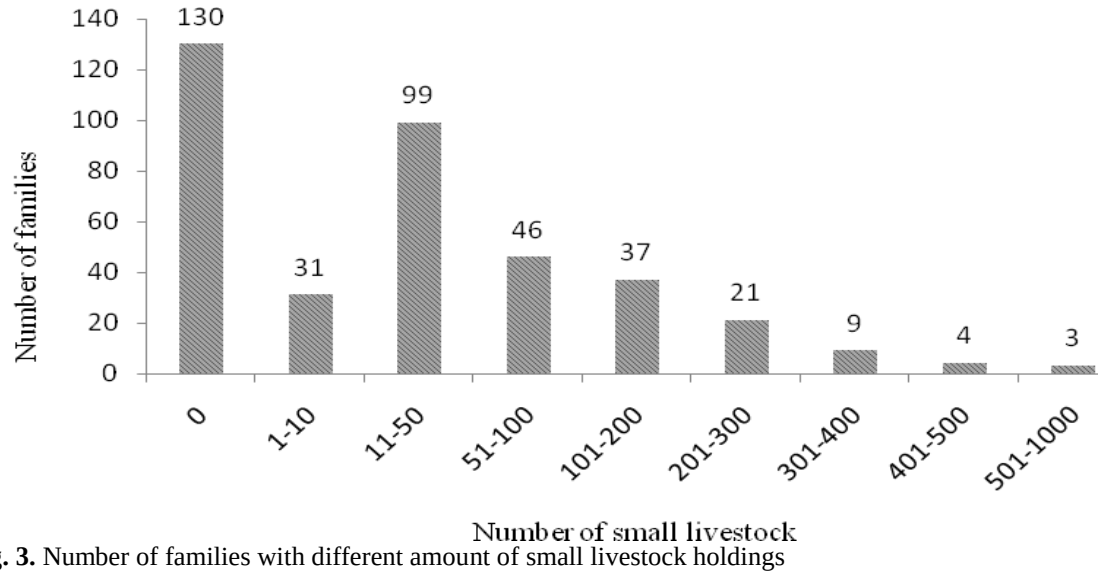

Fig. 3. Number of families with different amount of small livestock holdings

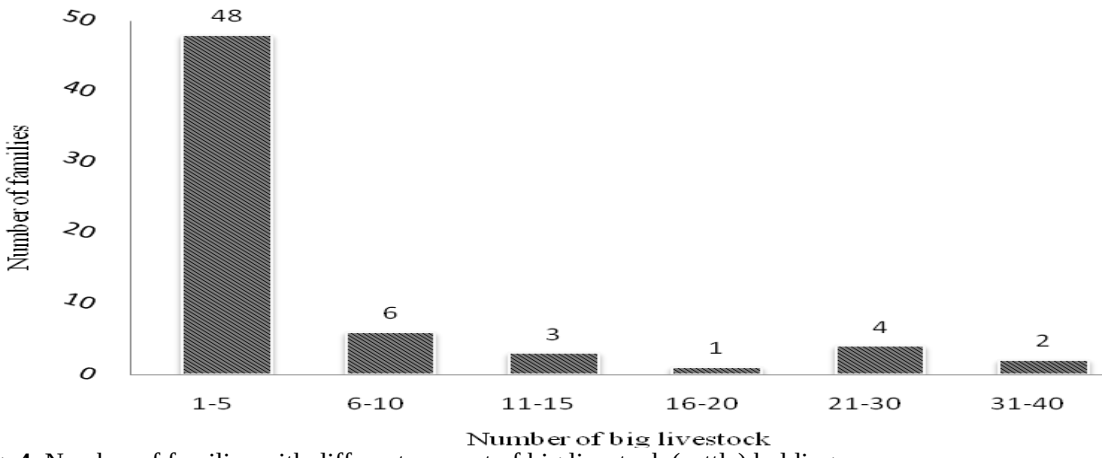

Fig. 4. Number of families with different amount of big livestock (cattle) holdings

Tables 2 showed result of T-test for comparisons between two groups of dependant and independent villagers on rangeland. There were significant differences in size of farm, size of orchard, number of small livestock, total livestock and total natural capital point of view. The results indicate that dependent group had higher values for above factors except size of orchard holding (Table 2).

Table 3 shows the results of Mann-Whitney U test for the nonparametric variable of the study. It helps identify whether there is any significant difference between the two groups or not. Table 3 shows that those people who have more access to rangeland (grazing right) are more dependent on rangeland.

Table 2. Mean comparisons between dependent and independent groups using T-test

Indicator Factors	Independent Group	Dependant Group	Levene's F Test Equality of Variances	Student t-test Equality of Means
Size of farm holding	3.34±0.271 b	5.25±0.321 a	11.92**	-4.58**
Size of orchard holding	3.44±0.281 a	2.40±0.282 b	6.07**	2.60**
Size of farm +orchard holding	6.04±0.272	6.21±0.308	1.87 ns	-0.415 ns
Total livestock	0.70±0.104 b	4.58±0.266 a	248.21**	-14.21**
Number of small livestock holding	1.28±0.049 b	1.85±0.039 a	7.65**	-8.30**
Number of big livestock holding	0.52±0.093	0.51±0.070	0.72 ns	0.075 ns
Total natural capital	6.41±0.256 b	7.81±0.235 a	14.51**	-3.99**

Mean values two dependent and independent groups in each rows with different letters are significant based on T-test ns, and **= non significant and significant at 0.01 probability level

Table 3. Mann-Whitney U test in relation with dependent and independent groups on rangeland right

Groups	Natural Capital Indicators Ranks	Z Values
Dependent	264.78 a	13.406**
Independent	125.73 b	

**= significant at 0.01 probability level

The binary logistic regression model was applied to identify some of the factors that could determine whether a villager keeps livestock dependent on rangeland or not. Based on the results of Omnibus test, model was fitted properly with values of (Chi-square=9.18, p<0.001). The values of -2 Log likelihood, Cox and Snell R^2 and Nagelkerke R^2 and Hosmer-Lemeshow Chi-square is presented in Table 4. The values reveal how independent variables can predict the odds that a villager will decide to keep livestock dependent on rangeland. The -2 Log likelihood statistic value was equal to 167.6. This statistic showed how properly the model predicts the dependency on rangeland. Both Cox and Snell R^2 and Nagelkerke R^2 statistics reveal that the independent variables predict the odds (61% - 82%) that a villager will decide to keep livestock dependent on rangeland. The Hosmer-Lemeshow test, with values of (Chi-square=13.305, p<0.102) revealed that predicted probability of the criterion variable fitted properly at final step of equation.

Table 4. Summary of logic regression startistics

-2 Log likelihood	Cox & Snell R^2	Nagelkerke R^2	Hosmer-Lemeshow test Chi-square
167.68 e	0.610	0.814	13.305 ns

ns= Chi-square values is not significant

The figures pointed out in Table 5 can be used to predict the probability of dependence on rangeland based on a one unit change in an independent variable when all other independent variables are kept constant. Among all independent variables studied in this research contributing variables computed in logistic regression model at final step were: number of small livestock and rangeland right[4].

[4] Rangeland grazing right: 1 is rangeland grazing right on rangeland surrounding the village and; 2 is rangeland grazing right on the communal rangelands

Table 5. Coefficients of regression, standard error and Wald test for logistic regression analysis

Indicator Factors	B	S.E.	Wald	Sig.	Exp (B)
Number of small livestock	0.056	0.008	36.268	0.000	1.057
Rangeland grazing right	-3.9345		75.951	0.000	
Rangeland grazing right(1)	-4.554	0.736	38.246	0.000	0.011
Rangeland grazing right(2)	-3.333	0.416	64.080	0.000	0.036
Constant	0.200	0.301	0.441	0.506	1.222

Rangeland grazing right :(1) is rangeland grazing right on rangeland surrounding the village and; (2) is rangeland grazing right on the communal rangelands

Based on the B values in Table 5, the final equation of dependence on rangeland was extracted:

$$Logit(y) = \ln(\frac{\pi}{1-\pi}) = 0.2 + 0.056x_1 - 3.9435x_2$$

Equation (1)

Where

X_1 is number of small livestock;

X_2 is rangeland right;

Discussion

Based on the results of the analysis, there were significant differences between the two groups of villagers in terms of farm size, orchard size, number of small livestock, total number of livestock (big and small), rangeland grazing right and total natural capital. Analysis revealed that villagers who had larger farms, smaller orchards, more small livestock, more livestock, greater amount of total natural capital and grazing right on rangelands were more dependent on rangeland. Due to changes that have happened among the villagers in the HableRud basin which is going to be common in most villages across the country, livestock keeping is a complementary activity of villagers and usually those villagers who can earn their livings from an easier source of livelihood such as orchard or even big livestock keeping, then they will prefer to leave small livestock keeping dependent on rangeland due to its high labor demand and hardship. But on the other hand, larger farms provide more hay and feed for livestock thus the owners of larger farms are encouraged to keep more livestock dependent on rangeland. But villagers who had more small livestock either due to their own interest or culture or because they lack any other reliable choice to maintain their living, should inevitably send their livestock to graze on rangelands while it is very costly to provide their feeds in case of stall feeding. Of course, during field visits and interviews, some villagers showed their stall with lots of livestock. They had their own reasons and economic calculation for livestock fattening. Meadow, straw, barley, bran and even tree twigs were seen to be given as feed to livestock. Note to mention that most of those villagers who reared livestock dependent on rangeland also mentioned that they had either shepherds or some sort of contract with the other herders to take care of their livestock. They mentioned that their sons did not take part in this activity. On the contrary, there were some young educated people, who bought livestock and involved with livestock keeping without having any grazing right or other natural capital such as farm and orchard.

Since big livestock usually do not graze on rangeland and are kept in pens so there was no significant difference between the two groups of villagers. But between the two groups, significant difference in terms of total livestock was seen which it seems that this indicator is not a good indicator to predict villagers' dependence on rangeland because this indicator is mixed of both small and big livestock.

The analysis showed that villagers with greater amount of natural capital are more dependent on rangeland but it could not be a fact because it covers grazing

right, number of small livestock, number of big livestock, total livestock, size of farm holding and size of orchard holding while as discussed earlier having grazing right and number of small livestock and size of farm holding are more appropriate to predict the dependency of a villager on rangeland than the other independent variables.

The results of this study is the same with Toulmin (1983) and Pelissier (1977) who mentioned crop producers are increasingly keeping livestock and herders increasingly engage in crop cultivation and pastoralists cultivate to supplement livestock products as stated by Kisamba-Mugerwa (1992). This research is also consistent with Bourn and Wint (1994) who stated that gradual integration of animal husbandry within local farming systems is recorded as farming became more common in the Sahel because some of the villagers settled in HableRud basin were previously just mobile pastoralists who gradually settled in the villages and involved with mixed crop-livestock farming.

This research confirmed Ellis (1998) and Bryceson (2002) that villagers' access to different livelihood capitals and opportunities shape the potential mix of activities. The results of this study can be applied by agricultural authorities either to promote or discourage rangeland dependent livestock rearing i.e. by promoting to keep big livestock or permission to convert farms to orchards, probably many people will leave livestock rearing dependent on rangeland. During the past decade National Forests, Rangeland and Watershed management Organization of Iran (FRWO) examined some measures to reduce the excess number of dependent families on rangeland, among them promotion of big livestock keeping by providing subsidized banking facilities, allocation of land for cropping and fruit growing were as well. The results of this study can help the concerned institutions to make the best decisions for dealing with rural families in terms of agricultural and even rural development.

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چکیده. فائو و بانک جهانی دامداری را به عنوان شیوه‌ای برای رفع فقر و امنیت غذایی خصوصاً در میان فقرای روستایی ترویج می‌کند. روستائیان معمولاً در کشاورزی مختلط زراعت–دامداری مشغول می‌باشند. مصاحبه‌های انجام شده با روستائیان حوزه حبله‌رود (در استان‌های تهران و سمنان) مشخص نمود که تغییراتی روی داده است و در مقایسه با دهه‌های قبل، روستائیان کمتری به دامداری می‌پردازند. آن‌ها اعتقاد داشتند که تعداد روستائیانی که اقدام به نگهداری دام در آغل می‌نمایند، نیز به شدت افزایش یافته است. این تحقیق برای دریافتن این که برخورداری از سرمایه‌های طبیعی تاثیری بر وابستگی روستائیان به مرتع دارد یا خیر، انجام شد. برای شناسایی سرمایه‌های طبیعی مهم در وابستگی روستائیان به مرتع، مصاحبه‌های ناساختار یافته و ساختار یافته با مردم محلی انجام شد. برای پی‌بردن به این که آیا اختلاف معنی داری میان دو گروه روستایی وابسته و غیر وابسته به مرتع از نظر شاخص‌های شناسایی شده وجود دارد، از روش‌های آماری T-test نمونه‌های مستقل و من‌ویتنی‌یو به ترتیب برای شاخص‌های با داده‌های پارامتریک و غیر پارامتریک استفاده شد. سپس برای پیش بینی احتمال وابستگی یک روستایی به مرتع بر اساس میزان برخورداری از متغییرهای مستقل، از رگرسیون لجستیک با استفاده از نرم افزار SPSS استفاده شد. تحلیل توصیفی داده‌های گردآوری شده حاکی از آن است که تنها ۱۷۷ خانوار از مجموع ۳۸۰ نمونه مورد بررسی، به مرتع وابسته می‌باشند و سایر روستائیان به مرتع وابسته نمی‌باشند. نتایج این تحقیق نشان داد که اختلاف معنی‌داری میان دو گروه وابسته و غیر وابسته به مرتع از نظر حق بهره‌برداری از مرتع، اندازه مزرعه، اندازه باغ، تعداد دام کوچک، تعداد کل دام و میزان سرمایه طبیعی خانوارها وجود دارد. اما بهترین شاخص‌ها برای پیش‌بینی وابستگی یک روستایی به مرتع، حق بهره‌برداری از مرتع، تعداد دام کوچک و اندازه مزرعه می‌باشد. این تحقیق همچنین نشان داد که متغیرهای مستقل می‌توانند بخت این که یک روستایی تصمیم بگیرد دام وابسته به مرتع داشته باشد، را با ۶۱-۸۲ درصد پیش بینی کنند.

کلمات کلیدی: دام، وابستگی، مزرعه، باغ، حبله رود