

ASSESSING THE ROLE OF BIODIVERSITY IN SUSTAINING LOCAL COMMUNITY IN DISTRICT HANGU, KHYBER PAKHTUNKHWA

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ABSTRACT

The link between biological diversity and the livelihood of a community has always been important and is of great significance in all eras. This study¹ aims to analyze the role of biodiversity (flora and fauna) in sustaining the livelihood of local community in six different villages of district Hangu, KP. The study is based on primary data collected through well-structured questionnaire from the owner of privately conserved areas, local residents, farmers, wood cutters, wood sellers, hunters, honeybee keepers, shepherds/cowherds and Hakeem/local medical practitioners. Data is analyzed through descriptive statistics, binary logistic and liner regression. The results showed that the livelihood of local community is significantly dependent on biological diversity of nature, and it significantly contributes to local economy at district Hangu.

Keywords: Biological diversity, role and loss, privately conserved areas, livelihood, descriptive statistics.

JEL Classification: Q57, Q59.

INTRODUCTION

Biological diversity requires our attention for two reasons. First, it provides a wide range of indirect benefits to humans. Second, human activities have contributed and still contribute, to unmatched rates of biodiversity loss, which threaten the sustainability and continuity of ecosystems as well as their provision of goods and services to mankind (Pimm et al., 1995; Simon, 1995). Biodiversity is sometimes not easily understandable, difficult to measure and it usually involves national and international involvement for conversation. While measuring the benefits and losses of biodiversity we need help from economic laws and principles, however since all goods and services provided by the species or ecosystem do not have a market price, nor they can be traded, so measuring biodiversity is challenging. Somehow economic analysis has managed to solve this issue to some extent; like applying economic valuation techniques to measure the loss or benefits provided by the biodiversity, roughly. By using different econometric techniques and economic policies, we may determine those policies that may help in reducing the loss of biodiversity and in sustaining the biodiversity. Political economy also plays a vital role in conservation of species as biodiversity and ecosystem do not respect international orders, sometimes the action in one region affects the biodiversity of another region and mostly diverse ecosystem lies in less developing nations of the world (Helm & Hepburn, 2012). Many of nature's advantages to people are amplified by biodiversity, including climate regulation and wood production in forests, cattle feed in grasslands, and sea food in aquatic environments (Isbell, 2017). Agricultural

¹Acknowledgement: This paper has been extracted from MPhil thesis by Fatima Athar (2014-17), which was sponsored as a project by HEC under the supervision of Dr. Anwar Hussain, and M. Imran Khan worked as a researcher as well as enumerator in the project.

pollution is constant source of worry in environmental management. Pollutants like organic compounds, nitrates and phosphoric compounds are very damaging to the environment and living beings in it. Pavlidis (2018) studied that tree roots in agroforestry systems can reduce nitrogen and phosphorus fragments in soil by 20 to 90 percent, and provide additional ecosystem benefits like soil quality improvement, erosion control and beneficial outcomes on biodiversity.

Some studies on prospective impacts on animal diversification (e.g. pollinators, herbivores and predators) have shown the long term effects of livestock grazing on the biological conservation and land quality. Livestock grazing causes unavoidable cost to global biodiversity that must be evaluated, alongside economic and social benefits (Filazzola, 2020). It is quite natural that population growth is the main cause of food scarcity, cutting of trees and other damages to landscapes and resources. Changes in environment affect the living organisms of the area and also when human population enters in an area; it affects its ecosystem, destroys plants and trees, and kills the animals that are threat to human life. When nature is disturbed due to deforestation, excessive constructions and infrastructures, then nature reacts in the form of storms (hurricanes, tornados), droughts, floods and destruction on massive scale (Worm et al., 2006).

The Economics of Biodiversity Loss

Sometimes there exists a gap between social costs and private costs in a society and the habitants of a particular area can't figure out how to use the natural resources sustainably or save them for the coming generations. This confusion creates the loss of biodiversity in that ecosystem. Private benefit and costs means those gains and losses which any entity receives on individual level; e.g.; a consumer, an industrialist, a farmer etc. Whereas social costs and benefits are those losses and gains which any society is receiving collectively, as a whole. Sometimes what is good for the individual may or may not be acceptable for the society, referred as "externalities". So, if seen through the eyes of individual, one particular act may exploit biodiversity but from the society's perspective it is just a sustainable way to utilize that natural resource (McNeely, 1988). Dietz and Adger (2003) discusses that if we realize that the growth in biodiversity may give rise to income, then more money would be spent on preservation of the biodiversity.

Habitat loss is usually regarded as one of the most important factors causing the global biodiversity crisis (Sala et al., 2000). Similarly in another study, Brooks et al. (2002) analyzed that land-use change has been proved to be a remarkably good predictor of the number of threatened or extinct species in biodiversity hotspots. Rais et al. (2010) analyzed that wetlands all over the world are drying rapidly, hence becoming the cause of vanishing Flora and Fauna. Kallar Kahaar lake is drying rapidly and becoming the reason for the death of birds and other animals' dependent on the lake. A study by WWF in 2000 says that in Pakistan, wetlands are under great threat due to siltation, deforestation and land-reclamation. The Human-Carnivore conflict mostly results in the destruction of carnivore species because they harm the villages and settlers and in return, are killed. A study in Kashmir revealed that in 3 years (2004-07), four leopards killed 363 farm animals like goats and sheep. Diseases are also one of the main reasons in livestock loss, urging the local authorities to provide vaccines and medicine to farmers, in order to save their livestock (Dar et al., 2009). Climate change has instigated numerous impacts on the biodiversity and ecosystems all over the world. Due to the cold temperatures during their migration period, many bird species are spotted early. Some regions have noticed an increase in pests and insects. Agricultural yield is severely affected, rise in sea levels and climate change has a negative influence on marine life, resources, and coral reefs (Irshad, 2008). It is estimated that over one-third of global food production depends on pollination and many parts of the world completely rely on honey bees as commercial pollinator of certain crops, but from past few years honey bees are decreasing in certain parts of the world (Neumann & Carreck, 2010). Honeybees are adversely affected by many reasons, like pest's diseases which include mites, viruses, fungal and bacterial diseases. Vegetation is one of the most important factors which ensure the survival of honeybee colonies because plants provide nectar, pollen and other nutrients to honeybees. Crop rotation reduces the production of seasonal flowers, similarly if droughts or excessive rainfall occurs, it destroys the flowers and thus effects honeybees negatively. Temperature and humidity are also key factors in sustainability of honey bee colonies (AFSSA, 2009).

Biodiversity in Hangu District, KPK

Hangu is a town in Khyber Pakhtunkhwa province of Pakistan. Hangu is famous for its greenery, hills, beauty and water. Hangu is situated in the northern half of Pakistan's Federally Administered Tribal

Areas (FATA). It is about 42 km away from Kohat. Hangu was a tehsil of Kohat, but in 1998 it was announced a district in Kohat Division. There are mountains around Hangu like Sarozai khalwati, Kata Karni, Pora Ghar, Shalmas Pir, Lakay Ghar and Samana. This small city of Khyber-Pakhtunkhwa has one of the most beautiful villages like Saidan Banda, Naryab, Karbogha Sharif and Dallan. There are many kinds of animals and plants found in Hangu like wild cats (*Felis chaus*, *Prionailurus viverrinus*), wolves and pangolin in some villages which indicates the availability of a variety of species in the district (Khan, 2012).

Economic Significance of the Species Selected in the Study

The species included in this study are some of the famous species of birds and plants in Hangu. Game birds like “Black Francolin (Kaala Teetar), Chukar Partridge (Chakor) and Grey Francolin” have their market values depending on several qualities of the birds like age of the bird, size of the bird and race of the bird. These species are sometimes sold and bought online as well e.g., the price of Black Francolin on “bole.com” ranges from 3000 to 55,000 rupees in Pakistan. The variation in prices is mostly because of the sounds a bird produce, i.e.: how many sounds per minute a bird can produce. The bird’s type (family), age, color and size are also the determinants of its price in the market. Profile of some species is given in Table: 1, the market value of species varies across different markets and depends on the age of the bird at selling time. The detailed information from pilot survey is shown in results and discussion section.

Study Area: District Hangu

Hangu district consists of valleys surrounded by east west trending mountains ridges. Hangu is covered by tribal area in the northwest and south. In the north, it has Orakzai agency, Kurram Agency in the west, North Waziristan in the southwest, Karak and Kohat districts are located in the southeast and east, respectively. It has an estimated population of about 391,000 during 2004-05 and 315,000 as per 1998 Census. In Hangu, Individuals like hunters, wood cutters and honeybee keepers are largely dependent on different species whereas some also depend on medicinal plants like Mazari Palm and eatable plants like Chong (Ahmad & Khan, 2010).The universe of the current study was confined to these 6 villages in Hangu; Sarozai, Doaba, Torawari, Naryab, Srazmaka and Karbogha Sharif.

DATA AND METHODOLOGY

This study is based on primary data and it has used quantitative tools (binary logistic, linear regression and descriptive statistics) to analyse the indicators of role of biodiversity. The data of the current study was collected, and some of the interviews with local experts were conducted with the help of an enumerator², who resides in Hangu and is well aware of the local knowledge and mindset of the people of Hangu. The questionnaires were filled (through the help of enumerator) from 6 different villages of Hangu; Sarozai, Doaba, Torawari, Naryab, Srazmaka and Karbogha Sharif.

Sampling Design

The respondents of the survey consisted of selected households, hunters, owners of privately conserved areas, farmers, wood cutters, wood sellers, bird sellers, Sheppard/cowherd and Hakeem (local medical practitioners). The sample size for each category along with their sampling method is given in table: 1.

Table No. 1 Sample Size Allocation and Sampling Technique

Respondents	Sample size	Sampling method
Owner of privately conserved areas	20	Purposive
Local residents	100	Simple random
Farmers	30	-do-
Woodcutters	30	Purposive
Wood sellers	20	-do-
Hunters	20	-do-
Honey bee keepers	10	-do-
Shepherd ³ /Cowherd ⁴	20	Simple random
Hakeem / local medical practitioners	10	-do-

² Muhammad Imran Khan

³ A person whose job is to take care of sheep and move them from one place to another (Cambridge dictionary)

⁴ A person who takes care of herd of cows or buffaloes (Oxford living dictionary)

The detailed information about the name of indicators, type of respondents from whom the relevant information was taken and the tool of data collection, followed by the procedure for the analysis of each variable, is given in the following table.

List of Indicators and their Methodology

Indicators	Respondents	Data Collection Tool	Methodology
Protected Area (privately conserved areas)	Owner of privately conserved areas	Questionnaire	From the owner of the privately conserved areas, the information on nature of protected areas, species available in the protected area, land covered by the protected area, hunting schedule, registration for hunting and penalties imposed on hunting in the protected areas were taken and analyzed through descriptive statistics.
Income of wood sellers	Wood sellers	-do-	From wood sellers, information on trips of wood supplied per day/per week, cost of supplying logs of wood from forest to market, number of stacks (in case of Mazari Palm and Chong) and logs (in case of large trees) sold per day /per week, was taken and analyzed through descriptive statistics.
Loss of biodiversity	Hunters ⁵	-do-	From hunters, information on hunting methods, hunting period, beginning and end season of hunting, most hunt species, hunting purpose, type and number of species reduced in last few years, and the loss faced by hunters due to specie loss was taken and analyzed through descriptive statistics and regression analysis.
	Honey bee keepers (both natural and farm)	-do-	Form honey bee keepers (natural and farm), information on loss of honey bee over the time period, loss of natural honey and variation in prices of honey (natural and artificial) was taken and analyzed through descriptive statistics.
	Local residents	-do-	From local residents, information on loss of birds, plants and honey bee along with perception of the respondents were taken and analyzed through descriptive statistics and regression analysis.
Open Access Hunting	Hunters	-do-	From hunters, information on hunting schedule, restrictions, penalties and methods of hunting was taken and analyzed through descriptive statistics and regression analysis.
Open Access Grazing	Shepherds/ Cowherds	-do-	From shepherds, information on number of cattle grazing, duration of grazing, and presence of sign boards/restrictions was taken and analyzed through descriptive statistics and regression analysis.
Income	Local residents	-do-	The information on source of income, amount of birds captured/plants cut per day, per specie/per unit market price, effect on income due to loss of species over time and perceptions on availability of the species under study compared to last few years

⁵ Experts like DPO Kohat, Tehsil Conservator officer, SHO Doaba and a forest officer "Oulasi" were interviewed about the laws and regulations regarding illegal hunting in the study area.

			was taken from local residents, whose livelihood depends on income generated by birds' and plant species. This information was later analyzed through descriptive statistics and regression analysis.
Local Medical Practitioners	Hakeem	-do-	From Hakeem/local medical practitioners, the information on type of medicinal plants, use of Chong and Mazari Palm in medicines, their market price, quantity used per packet/stack, name of medicine and diseases for which it is made, impact of availability of these plants over the time period and increase in prices of the medicine made by these plants due to the shortage of Chong and Mazari palm in last few years, was taken and analyzed through descriptive analysis.

Regression Models

- I. To estimate the impact of grading and hunting of species and change in the number of springs on total income from species, the following regression model has been estimated:

$$TYS = b_0 + b_1GRAD + b_2HNT + b_3SPR + e_i \dots \dots \dots (2.1)$$

where,

TYS: total income from species in rupees per month, dependent variable

GRAD: grading of species, it is dummy variable taking value 1 if respondent properly grade the species (plants and birds) and, 0 otherwise

HNT: hunting of species, it is dummy variable taking value 1 if respondent hunt species of birds and, 0 otherwise

SPR: springs declined, dummy variable taking value 1 if the number of springs has declined overtime in study area and, 0 otherwise

b's are the parameters to be estimated and e_i is the error term

- II. To estimate the impact of age and experience of the respondents, cattle grazing and restriction on the grazing, the following regression model was estimated:

$$TY = b_0 + b_1AGE + b_2EXP + b_3CG + b_4RST + e_i \dots \dots \dots (2.2)$$

where,

TY: total income earned through cattle in rupees per month, dependent variable

AGE: age of the respondent in years

EXP: experience of the respondent (shepard) in years

CG: cattle grazed, number of cattle grazed by the respondent daily

RST: restriction, dummy variable taking value 1 if the respondent faces any restriction for cattle grazing and, 0 otherwise

b's are the parameters to be estimated and e_i is the error term

RESULTS AND DISCUSSION

Table No. 2 Price of game birds in markets of Hangu

Hunting places of bird	Name of bird	Age of bird at selling time	Price of Bird	Markets names
Srazmaka Sarozei		3 to 20 days	Rs 500 to Rs 1000	Doaba, Thursday Market, Hangu City

	Black Francolin ⁶		Special bird Rs 1500	Friday Market
Karbogha		3 to 12 months	Rs 2000 to Rs 15,000.	Doaba Thursday Market, Hangu City
			Special bird Rs 20000	Friday Market
Muhammad Khawaja		1 year to 2 years	Rs 5000 to Rs50,000	Tall, Doaba, Hangu Markets
Torawari		2 years to 4 years	Rs20,000 to Rs30,000	Doaba ,Tall, Hangu Markets
Sarozai	Grey Francolin ⁷	3 to 20 days	Rs 300 to Rs500	Doaba Thursday Market
Naryab		2 to 12 months	Rs 800 to Rs 3000	
Sarki		1 year to 2 years	Rs 1500 to Rs 5000	Doaba ,Tall, Hangu Markets
Paskalay		2 years to 3 years	Rs 2000 to Rs 6000	Doaba ,Tall, Hangu Markets
Srazmaka Karbogha		3 years to 5 years	Rs 3000 to Rs 6000	Doaba ,Tall, Hangu Markets
Sarozai		3 to 20 days	Rs1000 to 2000	Doaba, Tall, Hangu Market,
Karbogha	Choker ⁸ Partridge	3 months to 1 year	Rs 2500 to 5000	Karbogha Sharif
Upper Naryab		1 year to 3 years	Rs 5000 to 12,000	

Source: The prices were taken in pilot survey by the enumerator from markets of district Hangu

Table No. 3 Price of honey in markets of Hangu

Places of availability	Type of honey bee	Price per quantity of honey	Markets to buy and sell
Naryab, Karbogha, Sarozai, Doaba and Tall, Hangu	Farm honey bee	Rs 1200 per kg honey from boxes (farm)	Sarozai, Doaba, Karbogha, Upper Naryab, Tall
	Natural honey bee ⁹	Rs 1400/Rs 1500 per kg honey from honey comb (natural honey)	

Source: The information was taken in pilot survey by the enumerator, from honeybee farms and markets of district Hangu.

According to the survey through markets of Hangu, it was observed that natural honey is costly as compared to the honey produced in farms, as the honey produced by natural process is becoming rare. When the population of farm honeybee increases in an area, they start killing natural honey bees from that area. Similarly, increase in the population of wasps in a particular area decreases natural honeybees in that area (Table 3).

⁶(*francolinus francolinus*)

⁷grey partridge (*Francolinus pondicerianus*)

⁸ (*Alectoris Chukar*)

⁹ (*Apis*)

Table No. 4 Price of the plant species in markets of Hangu

Names of plants	Places of availability	Quantity	Prices	Place of Markets
Chong ¹⁰	Torawari, Naryab, Karbogha Sharif, Dallah, Toghsarai, Darband, Kotkay. Sarozai	1 kg	Rs 180-Rs 280	Sarozai, Doaba, Karbogha upper Naryab, Tall, Hangu
Mazari Palm ¹¹	Torawari, Naryab, Karbogha Sharif, Dallah, Toghsarai, Darband, Kotkay, Sarozai and Banda sherawan	Small stack of Mazari Palm Large stack of Mazari Palm	Rs 50 Rs 100 Rs 500- Rs1000	Sarozai, Doaba, Karbogha upper Naryab, Tall, Hangu

Source: The information was taken in pilot survey by the enumerator from different markets of Hangu.

a) Descriptive Statistics of Study Variables

Income and Livelihood Dependency

Only 5% respondents out of 100 (sample size)¹² were government employee like primary school teachers, postman etc., whereas 29 % were in a private sector as a wage worker, driver or a peon. 66 % was earning their income by selling different wild plants (like Mazari palm, Chong, khapyanga) and game birds (black francolin, grey francolin, and choker). Few households out of these 66 % were supported by their relatives who were in foreign countries. The results indicated that the livelihood of maximum number of households was dependent on the biodiversity of different plants and animals and they are a major source of income for the people of Hangu.

Table No. 5 Distribution of households by type of occupation

Source of income	Frequency	Percent
Government job	5	5.0
Private job/ businessman	29	29.0
Other sources (specify) ¹³	66	66.0
Total respondents	100	100.0

Demographic information of respondents' profession, associated with biodiversity

The results of the table 5 show the demographic characteristics of respondents. The results show that honeybee keepers are earning highest average income from natural honey, followed by income of wood sellers, wood cutters and Hakeem. Hunters are earning lowest average income among all the respondents, which indicates that birds' population has declined and hunters cannot easily find it to hunt and sell in the market. The study estimated that people with diversified experience backgrounds, are earning significant amount of money from the mountains in district Hangu, KP.

¹⁰(*Caralluma Fimbriata*)

¹¹(*Nannorrhops Ritchiana*)

¹² The sample size consists of local residents of Hangu who were selected randomly, the livelihood of some of those was not dependent on any species while the rest of them were earning through species of plants and birds.

¹³Other sources of income included income earned through wild plants (like sisal, Chong, Khapyanga), income earned through birds (like francolins, choker) and in some cases through remittances (foreign earnings) by different respondents.

Table No. 5 Demographic information of different professions in Hangu associated with biodiversity

Type of Respondent	Age (years)			Income (rupee/month)			Education (years)			Experience (years)			Family size (number)		
	Min	Max	Average	Min	Max	Average	Min	Max	Average	Min	Max	Average	Min	Max	Average
Owner of privately conserved areas	23	40	54	12,000	26,000	40,000	0	5	12	3	8	20	4	6	9
Dependent Household	26	39	61	500	15,470	35,000	0	3	8	0	0	0	2	7	14
Hunter	20	33	42	0	4,750	15,000	0	5	16	3	9	20	2	4	7
Farmer	27	39	54	800	23,466	40,000	0	8	12	3	13	30	2	5	11
Honey Bee Keeper (farm and natural)	28	41	49	20,000	39,000	70,000	0	5	14	2	14	25	2	7	12
Wood Cutter	26	37	51	12,000	28,533	55,000	0	0	0	3	10	25	3	7	13
Wood Seller	28	38	49	20,000	36,550	65,000	0	0	0	3	7	13	2	6	13
Hakeem	36	45	55	25,000	37,500	55,000	10	12	16	4	11	10	6	9	13
Sheppard/Cowherd	22	33	48	800	15,000	20,000	0	0	0	3	10	15	4	7	14

*min shows minimum and max shows maximum

Average income of residents of Hangu from wild birds and plant species

Table 6 explains how livelihood of local residents of Hangu is associated with biodiversity of that area. In plants, maximum income was earned through Mazari Palm, followed by Chong. It showed the high significance of Mazari Palm, which was not only used as fuel (after drying it) but also in making handicrafts and strings by local residents. Another plant, Shard (*Stachytarpheta mutabilis*)¹⁴ is used in handicrafts but according to the locals, it has very low value in markets due to its abundance in Hangu so it didn't significantly contribute to the income of the local residents. Khapyanga (*Withania somnifer*) plant was used in medicines by local Hakeem. Birds contributed more towards income of local residents than plants however, the highest average income was earned by selling honey. Honey bee keeping is one of the main occupation and source of livelihood for people of Hangu and price of honey varies due to factors like experience of honey bee keeper, number of boxes on a farm etc.

¹⁴<http://herbaly.blogspot.com/2008/10/keji-shard-keji-beling.html>

Table No. 6 Average income of local residents earned through different species of plants and birds

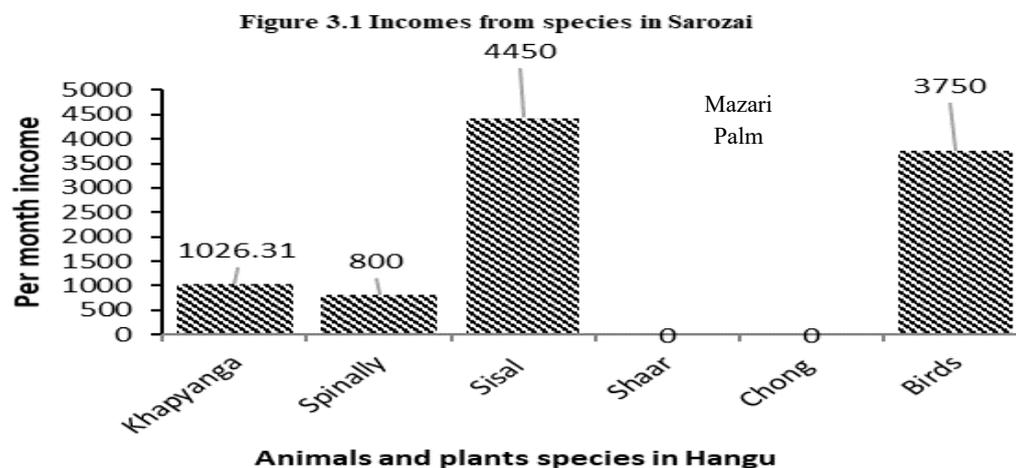
Income source of sellers/ local residents	Mean	Minimum	Maximum	No. of sellers
Shard	0	0	0	0
Khapyanga	2593	0	6000	16
Chong	5346	0	9000	13
Mazari Palm	5944	0	15,000	70
Birds (francolins & choker)	11,875	0	20,000	8
Honey bee	39,000	20,000	70,000	10

Location-wise average income of the residents of Hangu

According to the survey, in Sarozai maximum income is earned by selling Khapyanga plant (Rs. 1027) on average. The largest amount of Spinally was sold in Sarozai where Rs. 800 was earned on average. Mazari Palm was sold (despite Mazri Control Act¹⁵) for earning purposes in Naryab, with average amount of Rs. 6150. According to the survey, local residents are not aware of this Act and also no restrictions are made to stop the cutting of Mazari palm. Shard is the only plant which was not used for selling purpose in any of the six villages. Chong was means of income for the residents of Karbogha, with average amount of Rs.1921. The residents of Doaba were earning maximum income through selling birds which was Rs 11,500 on average.

Average income earned from different species in Sarozai

According to figure 1 the market demand for Mazari Palm is comparatively high as compared to other plants (khapyanga, spinally, shard and Chong). The income earned by selling birds' species (like grey francolin, black francolin and choker partridge) are on the second number¹⁶. Plants like khapyanga and spinally are also sold for income purposes in Sarozai.



¹⁵The Kohat Mazri Control Act, 1953. An act to consolidate and amend the law relating to the protection, preservation, propagation and control of Mazri and Mazri produce in the North-West Frontier Province. Mazri shall be a protected plant wherever it grows and except as provided by the Act, or rules made there under the cutting of its leaves, sheets, roots or stem shall be prohibited.

¹⁶ According to the information gathered during survey, hunting of grey and black francolin is illegal in some parts of Hangu whereas hunting of all other species is legal. During festivals local forest guard visits villages and buy baby birds of black or grey francolins in 300 to 500 PKR.

Average income earned from different species in Naryab

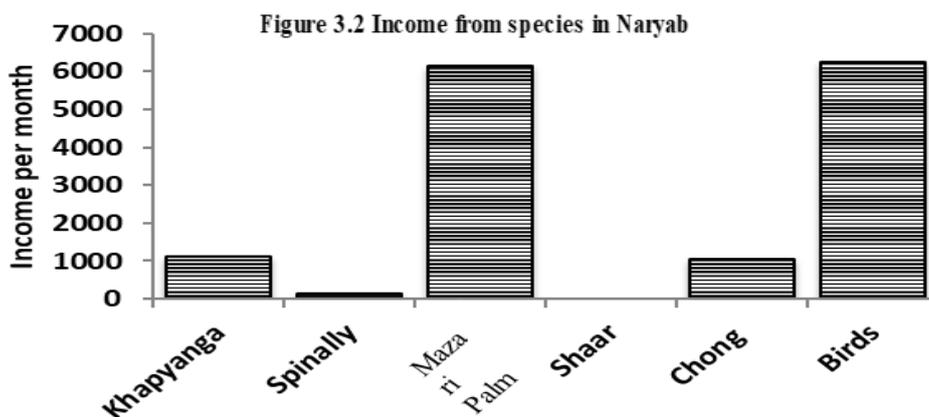
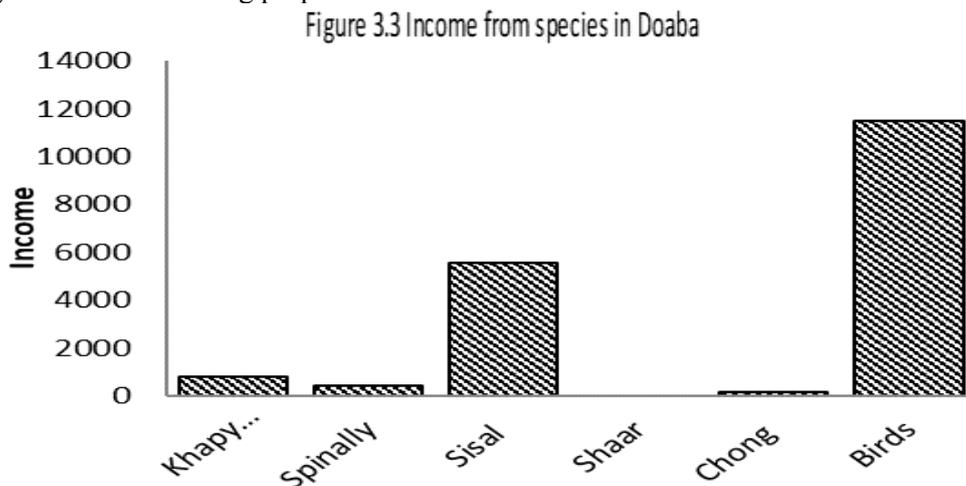


Figure 2 shows that birds and Mazari palm were mainly used for income in Naryab, contributing Rs. 6250 and 6150, respectively. Almost equal amount of income was earned by Khapyanga and Chong plants. Naryab is a rich place with respect to environmental and ecological amenities like dam, natural springs and forests which are full of wild life and other resources. It has also many protected areas especially for Mazari Palm, made by the villagers.

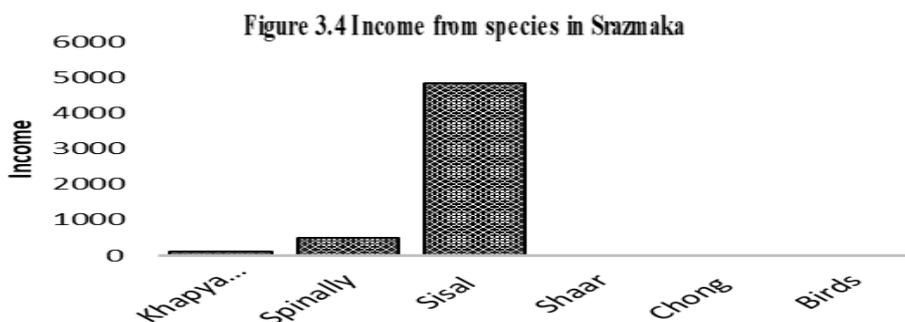
Average income earned from different species in Doaba

Maximum amount of income was earned through selling birds (francolins and partridge) in Doaba, i.e. 11,500 rupees. Chong is found in abundance in Doaba, but due to no significant market value, it is generally not used for earning purpose.



Average income earned from different species in Srazmaka

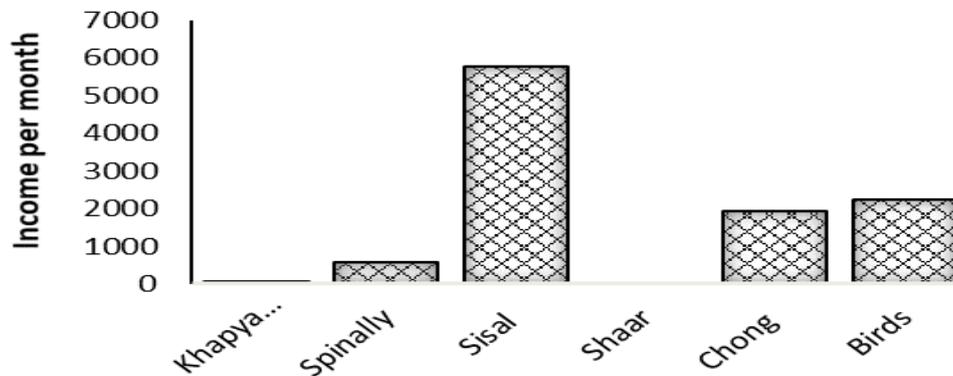
Figure 4 shows that Mazari Palm was the main specie which contributed 4850 rupees/month to the people of Srazmaka. Spinally and Khapyanga were also sold by a small number of people in Srazmaka.



Average income earned from different species in Karbogha

In Karbogha, mountains are very important source of life, providing Mazari Palm to locals for income generation with highest average income of 5,775 rupees/month (figure 5). Chong and birds are also sold with average income of 1921 and 2250 rupees, respectively. Khapyanga and spinally contribute very little for livelihoods of the locals.

Figure 3.5 Income from species in Karbogha



Role of species in education and health expenditures of households

Through survey it was noticed that the respondents who were mainly dependent on plant species, their education and health expenditures also got affected (table 8). When respondents were inquired about decline in their monthly income, only 14 % respondents had no affect by the species' decline in their area. The expenses on education of 88 respondents and health expenses of 86 respondents were affected due to income decline through these species. The reason of decline in income told by most of the respondents (96 %) was that the availability of Mazari Palm has declined over time therefore, it has become very time taking to collect these plants from mountains as compared to the last few years.

Table No. 8 Response of households on education and health

Statements	Response in (%)	
	Yes	No
No. of species declined in hunting area	90	10
Decline in monthly income due to decline in species	86	14
Education of children effected due to decline in income from the species	88	12
Health expenditures effected due to decline in income from the species	86	14
Increase in time spent on collecting Mazari, woods, hunting birds with quantity declined overtime	96	4

Econometric Analysis

- i. The results indicate that the income of respondents generating from selected species (birds and plants) is positively affected by hunting (Table 10). The coefficient “number of springs declined over time” is negative which indicates that due to decline in number of springs, the income from species has decreased over time. Grading¹⁷ of the species has positive and significant impact on revenue from the selected species.

¹⁷In Hangu, Mazari palm and Chong are generally harvested by the farmers in bulk to sell them in market. Mazari Palm is further used for handicrafts. The revenue from these plants can be increased further, if locals properly grade these products and sell them in markets. Similarly, francolins are captured and properly trained for fight and “sound producing” competitions. This process upgrades their value in the market (source: pilot survey).

Table No. 10 Regression results of the factors influencing income from species

Model	Coefficients	Std. Error	T	Sig.
(Constant)	3391.850	1654.621	2.050	.043
HNT	2445.994	1247.374	1.961	.053
SPR DEC	-1148.881	1049.174	-1.095	.276
GRAD	2514.241	745.029	3.375	.001
R Square	.168		Adjusted R Square	.142

Independent; HNT: hunting of species, SPR: springs declined overtime, GRAD: grading of plant species, Dependent; TYS: total income from species

- ii. To estimate the impact of various influencing factors on the total income from cattle/herd, the regression model has been estimated, results are given in table 9. The income of shepherd/cowherd is positively related to the experience of shepherd/cowherd, whereas the number of cattle/herd grazed daily is positively linked with income of shepherd/cowherd and it is statistically significant, which indicates that one unit of cattle/herd increases the income of shepherd/cowherd by 48 %. The coefficient of restrictions on grazing is negatively related with income of shepherds, hence restriction will discourage the shepherds/cowherds of the area to keep large herds and thus income of shepherds/cowherds will decline.

Table No. 11 Regression results of impact of influencing factors of income from cattle

Model	Unstandardized Coefficients		Standard Coefficient	T	Sig.
	B	Std. Error	Beta		
(Constant)	7972.863	3410.594	.067	2.338	.034
AGE	32.328	169.357	.254	.191	.851
EXP	265.460	373.538	.439	.711	.488
CG	48.065	20.874	-.350	2.303	.036
RST	-4371.308	2475.629		-1.766	.098
R-square	0.55	Adj. R. Square	0.42		

Independent; AGE: age of respondent, EXP: experience of respondent, CG: no. of cattle grazed by respondent daily, RST: restriction for cattle grazing

Dependent; TY: total income earned through cattle

CONCLUSION

This study showed that biological diversity and the livelihood of people residing in Hangu are closely associated. Medicinal plants like Chong and other plants like Mazari palm were influenced negatively due to climatic factors, which in turn have affected the income in the past 10-15 years. According to local experts, burning vegetation and old shrubs on mountains for the production of fresh grass for livestock has forced many bird's species to leave their habitats. This practice should be banned and restricted in Hangu.

The income of respondents from selected species is positively related with hunting. The number of springs declined over time has negative impact on the income from species. If species are sold after proper grading and value addition, then income of respondents may further be increased. The income of shepherds is positively associated with experience of the shepherds. The number of cattle grazed daily is positively linked with income of shepherds. Furthermore, restrictions on grazing are negatively affecting income of shepherds; it implies that restriction on grazing will lead to decrease the income of shepherds.

RECOMMENDATIONS

- Open access hunting and illegal methods of hunting should be controlled by the government of KP and trophy hunting should be encouraged in Hangu.
- Local government should take notice of the regulation and implementation of Mazari palm in Kohat (Hangu).

- The areas which are not protected should be conserved, in order to ensure the safety of habitat of many species and rich biodiversity in Hangu.

Due to time and resource limitations, the author could not include many other significant species (like pangolin) which are equally important in playing their roles in the livelihood of people, hence further research can be carried out in this area.

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