International Journal of Information Movement *Vol.2 Issue VII* *(November 2017)*

Website: www.ijim.in *ISSN: 2456-0553 (online)* **Pages 217-225**

CHANGES IN LAND USE PATTERN DUE TO HAZELNUT PROJECT IN NGATSANG GEWOG, MONGAR, BHUTAN

Sangay Tshering
Royal Thimphu College (RTC), Ngabiphu, Thimphu
Email: desangma06@gmail.com

Dr. Rekha Chhetri
College of Natural Resources, Royal University of Bhutan
Lobesa, Punakha
Email: rechhetri@gmail.com

Kinley Dorji
M.Sc. Environment Management
Email: pemagatshel108@gmail.com

Abstract: A study carried out in Ngatsang Gewog under Mongar Dzongkhag, Bhutan to find out what factors motivated farmers to participate in hazelnut plantations and also to determine the changes in land use pattern. The 70% of total hazelnut tree growers were selected through stratified random sampling method for questionnaire based survey. Data were analyzed using Statistical Package for Social Science (SPSS) version 16.0. A study found that the average land use increased from 37 acres to 44 acres after hazelnut tree plantation. Fallow land and dry land used increased from seven acres to 28 acres and 75 acres to 87 acres respectively after hazelnut tree introduction. Average annual income was Nu.55804 per households which was comparatively profitable than of Nu 34823 per households before hazelnut plantation. It has been concluded that the wild animal damage (29%), water scarcity (24%) followed by pest and disease infection (22%) to hazelnut trees were major constraints. Frequent monitoring and extension services should be made for the healthy growth of hazelnut trees.

Key words: Hazelnut trees, land use, Ngatsang Gewog, monitoring services, acres.

1.0 Introduction

Hazelnuts are grown around the world mainly in Mediterranean climates on steep slopes and hilly areas. Hazelnut is a popular nut worldwide**.** The three largest producers of hazelnuts are Turkey (70%), Italy (14%), and USA (4%) (Lippert, 2009). Hazelnuts are hardy plants with large fibrous root systems that are excellent for soil and water conservation**.** It is a promising third crop in Greater Blue Earth River Basin as its nutritional values are 10 to 22% protein, 55 to 72% lipids, 3 to 9% glucose (Ashoori & Noorhosseini, 2013). It is also an excellent source of vitamin E and B6 (Pulsipher & Josiah, 2001). It's an important product in most of the European countries being an important source of income for a large number of family farms.

Owing to typical geographical situation, Bhutan has considerable comparative advantages in production of hazelnuts where altitude of 1600-3000 meter above sea level ranges suitable in most of the places. Potential for hazelnut production in Bhutan has been established by Mr. Daniel Spitzer the founder of Mountain Hazelnut Ventures (MHV) which is the Bhutan's first 100% FDI agricultural project. Hazelnuts are a newly introduced crop to Bhutanese agriculture and it is both a first employer and first exposure to a corporate work environment. It is 100% export oriented project established collaboratively by Ministry of Agriculture and Forests and Mountain Hazelnut Venture. It's a social enterprise planting hazelnut trees in partnership with government and thousands of Bhutanese farmers representing over 15% of country's population.

MHV has an ambitious vision to make hazelnuts into Bhutan's second largest export industry after hydroelectricity (Christin, 2013). MHV has built the world's largest hazelnut nursery in a jungle valley in eastern Bhutan and to date has distributed 4.8 millions of hazelnut saplings to farmers in remote villages for sustainable production (Gol & Dengiz, 2007). Hazelnuts create opportunities for environmental friendly benefits as well as prevention of soil erosion. It is planted on fallow or deforested mountain slopes which are at risk of soil erosion. Establishment of hazelnut project in Mongar has also contributed to adverse impacts on rural-urban migration as youths are increasingly attracted to the lifestyle of urban areas for better jobs and livelihood standard.

2.0 Objectives of the study

The objectives of the study are to:

- Determine the changes in land use pattern due to introduction of hazelnut project.
- Compare the economic benefits of changing land use practices after introduction of hazelnut trees.
- Find out what factors motivated farmers to participate in hazelnut plantations
- Determine the impacts of hazelnuts on land use practices
- Study hazelnut tree management strategies and constraints in hazelnut cultivation

3.0 Methodology

3.1 Study Area: Geographically, Mongar Dzongkhag is characterized by a rugged and mountainous terrain with moderately steep slopes with elevation ranging from 240-4000 meter above sea level. It is located approximately between latitude 27°16'67'' N and longitude 91°16'67'' E with hot and humid climatic condition in summer and dry and cool in winter months (Wangchuk, 2008)**.** It is one of the most developing Dzongkhags in eastern Bhutan with the features of having a rich historical and cultural wealth and modern facilities like regional referral hospital and Kurichhu hydropower project. Mongar Dzongkhag has the total area 1,939.75 sq.km covering 17 Gewog. This study was carried out only in Ngatsang Gewog (Figure 1) where hazelnut trees are grown collaboratively with MHV. The selected survey area is suitable for hazelnut plantation as it falls within the feasible altitude range of 1600-3000 meter above sea level.

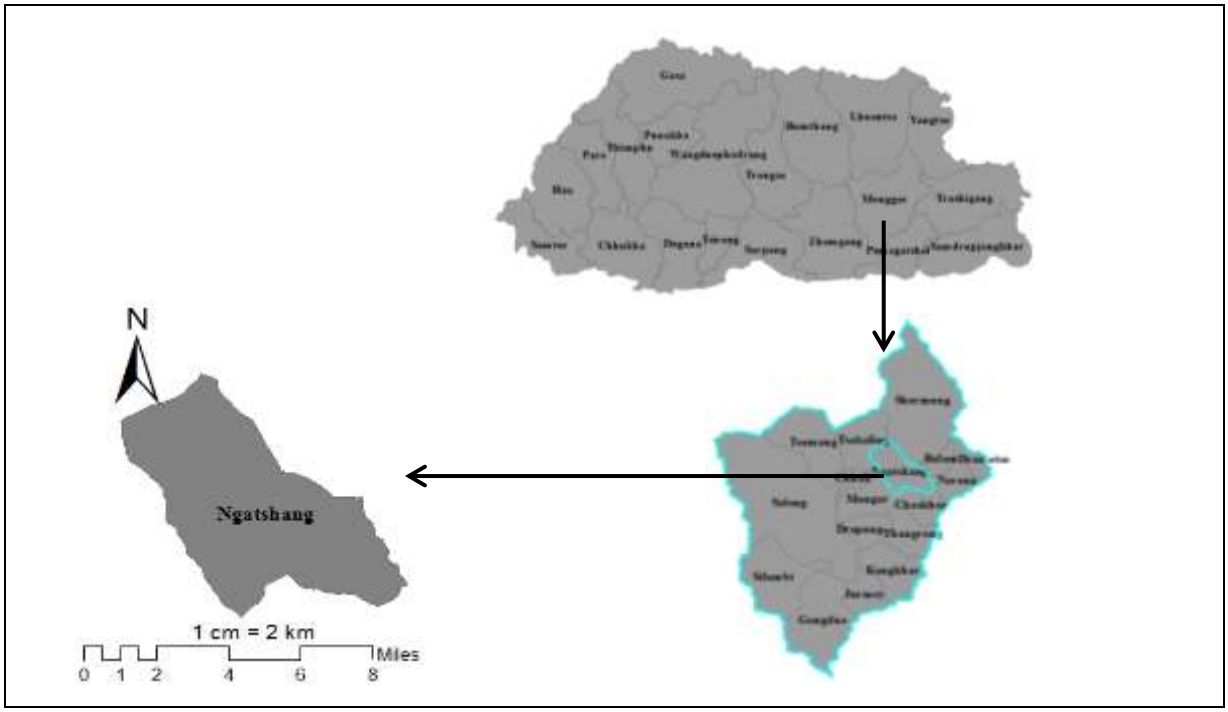

Figure 1. Study area

3.2 Sampling Procedures

3.2.1 Preliminary Field Preparation: Prior to data collection from study site, approval from Dzongkhag, Gewog administration and Mountain Hazelnut (MH) office was soughed to carry out the field study smoothly. To avoid communication gap and enhance in collecting appropriate information, concerned hazelnut field monitor of Ngatsang Gewog was informed beforehand to make hazelnut growers were well informed and all were aware of field study.

3.2.2 Pre Survey Meeting with Hazelnut Field Monitor: Before actual survey, a discussion was held with concerned hazelnut field monitor of the Gewog, hazelnut Contract growers (CGs) and a Tsogpa to select Chiwogs, households (HHs) and to plan the schedule for data collection. Lists of hazelnut growers were verified and updated on the spot to assure hazelnut growers to be present during survey.

3.3. Sample Size:

The 70 % of total hazelnut tree growers was taken as sample size for the survey and respondents were selected through stratified random sampling technique. Thus, the total number of respondents for survey was 31 out of 44 hazelnut tree growers in Ngatsang Gewog. Respondents were also presented from different villages of hazelnut planted areas.

3.4 Data Collection:

Data were collected from 31 respondents through face to face interview using semi-structured questionnaires from 25 December, 2014 to 6 January, 2015. Prior to actual survey, pretesting of questionnaires was done in Thumbari Chiwog for two households. According to National Statistics Bureau of Bhutan (National Statistics Bureau, 2013), working-age population of Bhutan is assumed between the age of 15-64 years. Therefore, without neglecting the gender biasness, respondents falling in those age range were interviewed semi-structured questionnaires to represent the information from different working age groups.

The respondent's identity was kept confidential and one member from each household was interviewed. Absentee respondents were interviewed following revisit. Other necessary information such as on altitude between the ranges of 1600-3000 meters above sea level was collected through discussion with hazelnut field monitors and Contract Growers (CGs).

3.5 Data Analysis:

Data collected were properly coded and entered in excel sheet and analyzed using Statistical Packages for Social Science (SPSS) program version 16.0. MS Microsoft excel 2007 spread sheet was also used to draw graphs, tables, and to analyze and interpret data. A Wilcoxon Signed-Ranks Test was computed to derive changes in land use pattern and to compare economic benefits of changing land use practices due to introduction of hazelnut trees.

4.0 Results and Discussions

4.1 Respondents Age Category :

The majority of respondents were female with 74.19% and male 25.81%. This indicated that most of the families in study area were headed by female. National Statistics Bureau of Bhutan (2013) had also shown that proportion of households headed by female were much higher in rural areas (34%) than in urban areas (19%) (National Statistics Bureau, 2013). Of total 31 respondents, Ngatsang Chiwog had the maximum with 17 respondents, Pelshup 6, Phanas 5 and Thumbari Chiwog with 3 respondents. The majority (42%) of respondents fall between age group of 35-44 and the least (6%) 15-25. A study found that respondents falling between ages of 25-54 were more confident in providing reliable information.

4.2 Household Land Holding:

Total land holding of respondents accounted 180.44 acres comprising wet land 38.72 acres, fallow land 35.48 acres and dry land 106.24 acres. The total area of registered hazelnut planted areas was 33.61acres with maximum of 16 acres in Ngatsang and minimum 4 acres in Thumbari Chiwog. Phanas and Pelshup Chiwog have total hazelnut growth areas 5.61 acres and 8 acres respectively. Other crops were cultivated in the back yard or in dry land surrounding farm house unlike hazelnut trees in registered areas. In study area, dry land (106.24 acres) dominated the land use practices. An area of 35.48 acres and 106.24 acres of fallow land and dry land respectively lies between elevation of 1600 and 3000 meter above sea level, which is used as a criteria in determining the feasibility for hazelnut plantation.

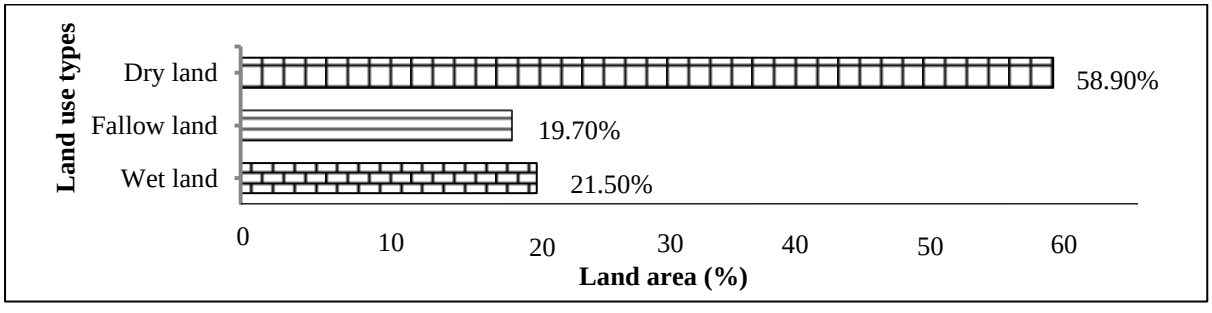

Figure 2. Land use in percentage

4.3 Land Use Before Introduction 0f Hazelnut Plantation:

Total areas of land types used before and after introduction of hazelnut trees are shown in Figure 3. Before hazelnut plantation in Ngatsang gewog, a total of 29.12 acres (75.21%) of the total 38.72 acres of wet land have been used for paddy cultivation. A total of 6.76 acres (19.05%) of total 35.48 acres of fallow land have been used as grass land and for fodder cultivation before hazelnut tree plantation. Farmers in Ngatsang Gewog have used 74.72 acres (70.33%) of dry land of the total 106.24 acres. A research in USA found that the different land use types led to improvement in farming system and livelihood. Similarly, this study also showed that farmers in Ngatsang Gewog use different land types to improve their living standard.

4.4 Land use after introduction of hazelnut plantation:

After farmers started hazelnut tree plantation, the cultivation in wet land gradually decreased to 18.16 acres (46.90%) of the total wet land. It has been concluded that the decreasing wet land use were due to water scarcity, labor shortages, youths migration to urban areas and wild animal damage to crops especially paddy. Conversely, use of fallow land increased to 27.65 acres (77.93%) of its total fallow land and dry land increased to 87.44 acres (82.30%) of the total dry land 106.24 acres (Figure 3). According to Chatterjee (2014), cultivation of new crops increased the agricultural land area by 4% in Sub-Saharan Africa. Similarly, introduction of hazelnut trees in Ngatsang Gewog has increased agricultural land area by 22.65 acres.

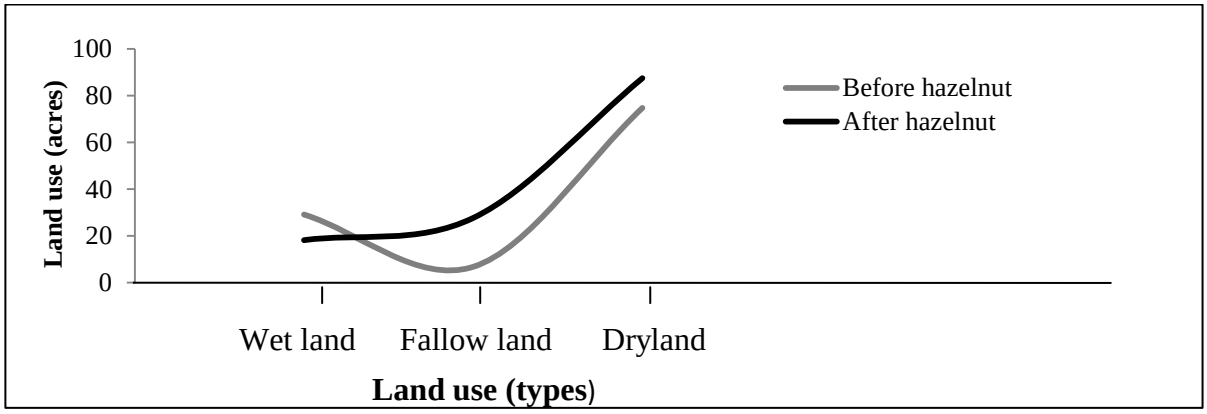

Figure 3. Changes in land use after introduction of hazelnut trees

4.5 Land Used for Hazelnut Cultivation

Introduction of hazelnut trees in Ngatsang Gewog has brought changes in land use practices as the prior land which were used for cultivation of other crops were now used for hazelnut plantation. The use of wet land decreased by 10.96 acres (28.31%) after hazelnut trees was introduced. Planting of hazelnut trees in wet land is restricted in accordance with agreement between RGoB and MHV. Before hazelnut trees were introduced to Ngatsang Geog, majority of lands were left empty or uncultivated but now those empty lands were cultivated with hazelnut trees. Of the total 35.48 acres, 20.89 acres (58.88%) of fallow land were used for hazelnut cultivation till date (2014). The use of dry land has also increased by 12.72 acres (11.97%) for hazelnut plantation. According to Wurtenberger *et al.*, (2005), they found that in Argentina agriculture was a main driver of economic development in sustaining the livelihood of Argentinean. Likewise, a total increase of 33.61 acres of land for hazelnut plantation would undoubtedly increase the income and improve livelihood of Ngatsang residents besides making land productive assets.

4.6 Potential Hazelnut Growth Areas

Hitherto hazelnut plantation, a total of 9.6, 28.72 and 31.52 acres of wet land, fallow land and dry land respectively were left uncultivated making the total 69.84 acres uncultivated land. With the introduction of hazelnut trees, uncultivated land reduced to 7.83 acres and 19.2 acres of fallow land and dry land respectively with a use of 33.61 acres for hazelnut plantation. Conversely, uncultivated wet land areas increased to 20.56 acres from 9.6 acres mainly due to water scarcity and human-wild life conflict particularly in remote villages. Another reason was labor shortages resulted from rural-urban migration. This study found that current uncultivated land was 47.39 acres which is comparatively less than 69.84 acres before hazelnut trees. The decrease in uncultivated land showed the introduction of hazelnuts has helped in minimizing the land remaining fallow. This study found that excluding wetland, a total potential hazelnut growth area (PHA) from dry land and fallow land was 26.83 acres (Table 1) whereas 33.61 acres were current hazelnut planted areas.

4.7 Factors Motivating Farmers to Participate in Hazelnut Cultivation

4.7.1 Favorable Climatic Condition : of the total 31 hazelnut growers, 83.87% of farmers responded that land falling in suitable altitude range between 1600 and 3000meter above sea level motivated them to participate in hazelnut plantation. Ngatsang Chiwog has the maximum potential hazelnut growth areas with 13 acres and least in Thumbari Chiwog with 3 acres. However, different Chiwogs have different altitude range (Table 1). According to Baldwin (2004), climatic requirement such as a mild climate with a cool winter and *mild summer* in an areas of south-eastern Australia were a main suitability criteria for hazelnut production unlike the criteria like elevation and aspects in Bhutan.

Table 1: Potential Hazelnut Growth Areas Based on Elevation

Chiwog	Elevation (masl)	Potential growth areas (acre)
Thumbari	1600-1700	3.00
Phanas	1679-1800	4.83
Ngatsang	1600-2000	13.00
Pelshup	1700-2000	6
Total potential growth areas		**26.83**

4.7.2 Land Availability: Mountain hazelnut requires a minimum of 0.5 acres of agriculturally unproductive lands for hazelnut plantation. Of the total hazelnut growers, 90.32% farmers responded that the excess uncultivated land influenced farmers to opt their land for hazelnut tree plantation. Registrations of land were on voluntary basis and opened to all types of growers (institutions, colleges, schools, individuals, groups, religious body etc). Hazelnut trees can only be planted on government land with the necessary approval from State Reserved Forest (SRF) lease.

4.8 Impacts of Hazelnut Trees on Land Use Practices.

Introduction of MHV created opportunities for environmental friendly benefits as 10 million hazelnut trees and 25,000 acres of orchard will add forest cover by end of the project. Of total 31 hazelnut growers, 80.65% farmers responded that hazelnut trees in Ngatsang Gewog improved the fertility and quality of top soil in orchards. Moreover, hazelnut trees have reduced erosion on steep slopes by its shallow root structures where topsoil layers were thin. Unlike in traditional agricultural practices, ground cover was also retained in orchard lands further aiding retention of topsoil and preventing surface sediment runoff. To reduce adverse impacts on land use practices, all the interviewees responded that hazelnut trees were planted productively in feasible areas with focus on sustainable land use practice. The conservative practices like A-frame, plastic mulching and minimal dosage of chemical fertilizers like dolomite and premixes were also used.

4.9 Economic Benefits of Changing Land Use Practices

4.9.1 Land Use and Annual Income Before Hazelnuts: The use of land types (wet land, fallow land, dry land) and annual income generation of respondents are shown in table 2. Before introduction of hazelnut trees in Ngatsang Gewog, farmers used 29.12 acres of wet land and generated Nu.425450 as an annual income through paddy cultivation. Respondents stated that only 6.76 acres of fallow land were used for pastures generated Nu. 6,500. As per the respondents, dry land dominated the land use types as 74.72 acres of total dry land106.24 acres were used for cultivation of various crops and vegetables. Respondents stated Nu. 647550 was an annual income generated through the use of dry land. An average annual income per households was Nu. 34823 from total income generated. A total uncultivated wet land, fallow land and dry land were shown in the Table 2.

Table 2. Land Use and Annual Income Before Hazelnut Tree Plantation

Landuse (type)	Land use before hazelnuts (acre)	land left uncultivated (acre)	Annual income (Nu.)
Wet land	29.12	9.6	425450
Fallow land	6.76	28.72	6500
Dry land	74.72	31.5	647550
Total	**110.6**	**69.82**	**1079500**

4.9.2 Land Use After Hazelnut Tree Introduction and Its Annual Income: There was increased in land use after establishment of MHV in Lingmethang and branch nursery in Ngatsang. Table 3 shows the use of

wet land, fallow land, dry land and their estimated annual income generation. The use of wet land decreased to 18.16 acres in 2014 mainly due to water scarcity. Lands close to woodlands which provide habitat for squirrels and highly erodible or poor drainage soil were the main limitations. Likewise water scarcity, labor shortage and wild animal damage to crops especially to paddy were the main constraints that limited wet land use in Ngatsang Gewog. As a result, uncultivated wet land increased to 20.56 acres. An annual income from wet land was Nu. 168630 which were comparatively less than annual income earned before hazelnut tree plantation. However, a use of wet land for hazelnut trees was strictly restricted.

The use of fallow land increased to 27.65 acres compared to 6.76 acres before hazelnut tree plantation. Uncultivated fallow land decreased to 7.83 acres as lands which were left empty were now planted hazelnut trees. As per the respondents, Nu.325450 was an annual income generated from use of fallow land. A research by Marongiu (2005) found that in some Italian areas such as in Viterbo, the hazelnut cultivation continued to play an important role in local economy. Similarly, this study found that income generation from hazelnuts was comparatively profitable than other agricultural activities.

This study found dry land was used for seven different potential fruit crops (maize, millet, wheat, banana, guava, and buckwheat and hazelnuts). The study identified maize and hazelnuts were cultivated by majority 67.74 % of respondents. A study by Cohoon & Stuckey (2010) found out that hazelnut growing region expands economically due to researches and developmental practices. In a similar way the use of dry land increased to 87.44 acres of total 106.24 acres due to free distribution of 210 and 420 hazelnut trees for 0.5 acres and 1 acre respectively to the farmers. Respondents stated that a total income of Nu .1235840 can be earned annually from dry land. The average annual income of households was Nu.55804 which was comparatively more than an average annual income of households before hazelnut introduction (Table 2 and 3).

Table 3. Land Use and Annual Income after Hazelnut Tree Plantation

Landuse (type)	Land use after hazelnuts (acre)	Land left uncultivated (acre)	Estimated annual income (Nu.)
Wet land	18.16	20.56	168630
Fallow land	27.65	7.83	325450
Dry land	87.44	18.8	1235840
Total	**133.25**	**47.19**	**1729920**

4.9.3 Increase in Land Use After Hazelnuts: To determine the increase in land use due to introduction of hazelnut trees, Kolmogorov Smirnov and Shapiro-Wilk normality test was carried out and showed it was not normal. So, 2 related sample tests (Wilcoxon Signed Ranks Test) were computed. A Wilcoxon Signed Rank Test indicated that the land use after introduction of hazelnut trees ranks Mdn=29.12, which was statistically significantly higher than land use before hazelnut trees Mdn=27.65, Z=1.069, p=0.285. This study concluded that after introduction of hazelnut trees, there was increased in land use. An average land use also increased from 36.86 acres to 44.42 acres. The maximum dry land used also increased from 74.72 acres to 87.44 acres (Table 4) after introduction of hazelnut trees.

Table 4. Increase in Land Use After Hazelnut Tree Introduction

	N	Mean	Median	Std. Deviation	Minimum	Maximum	*Z*	*P*
Before hazelnut	31	36.86	27.65	±34.63594	6.76	74.72	-1.069	0.285
After hazelnut	31	44.41	29.12	±37.56022	18.16	87.44		

4.9.4 Land Use and Projected Annual Income From Hazelnuts: Before 2010, the current hazelnut planted areas were used for different agricultural activities. At present, farmers have planted hazelnut trees in 33.61 acres in Ngatsang Gewog. Of the total hazelnut planted areas, a current 20.89 acres of fallow land which were once used for pasture development generated Nu.74540 annually. Whereas today, the estimated annual income of Nu. 631714 can be earned from hazelnuts making an annual income difference of Nu. 557174. According to Berger & Bolte (1997), it's difficult to draw economic conclusions as crop prices and markets will be different in future. However, we can get some idea of the economic implications by considering contract signed between RGoB and MHV.

Economic benefits from 12.72 acres of dry land for hazelnuts were compared based on different land use practices. When farmers used the land for cultivation of maize, wheat, millet, buck wheat and other crops, an

annual income generated was Nu. 379890. If a same size of this dry land (12.72 acres) were used for hazelnut production, an annual estimated income generation was Nu.384653 which is comparatively profitable than using dry land for agriculture production. If economic benefits were assessed based on the same size of land i.e. 33.61 acres for hazelnuts and agricultural crops, a total of Nu. 561936 can be earned more from hazelnuts than agricultural crops. A study showed that participation of Bhutanese farmers in international hazelnut market would benefit economically as the international current value of hazelnuts is £2/kg (Olsen, 2006). In this study, a costs for hazelnuts i.e. Nu 18/kg (30% of US$) were calculated as per the agreement signed between MHV and RGoB. Hazelnut production was calculated in kg i.e. 4kg/tree which was expected minimum as per the data maintained by MHV. Table 5 and 6 show comparative income generation of two different land use practices.

Table 5: Prior Land Use and Income from Agriculture Crops Before Hazelnut Introduction

Land use (type)	Land use (acre)	+9	Annual income (Nu.)
Fallow land	20.89	Pasture (Grazing land)	74540
Dry land	12.72	Maize, wheat and other crops	379890
Total	**33.61**		**454430**

Table 6: Future Economy Projection from Hazelnut Cultivation

Land Use (type)	land Use (In acre)	Hazel Trees Distributed	Estimated Production (Kg)	Cost Nu./kg(30% of US$)	Estimated income in Nu.
Fallow land	20.89	8774	35095	18	631714
Dry land	12.72	5342	21370	18	384653
Total	**33.61**	**14116**	**56465**		**1016366**

4.10 Constraints in Hazelnut Cultivation

Respondents were asked to identify and rate five identified problems in hazelnut cultivation based on severity, rank 1 being the most severe and 5 least severe (Figure 4). Majority (29%) of respondents ranked that wild animal damage to hazelnut trees was the most severe problem followed by water scarcity (24%) and pest and disease (22%). The least (2%) severe problems were limited capital (economy) followed by domestic animal damage (6%) and rural-urban migration (17%) which caused labor shortage in villages. As per the study conducted by Latmahalleh & Niyaki (2013), the most social issues facing hazelnut growers were lack of production cooperatives and state organization (85.71%), and high hazelnut farmers working age (71.43%) in Iran. Contrarily, this study found that the major challenges were wild life conflict and water scarcity in Ngatsang Gewog.

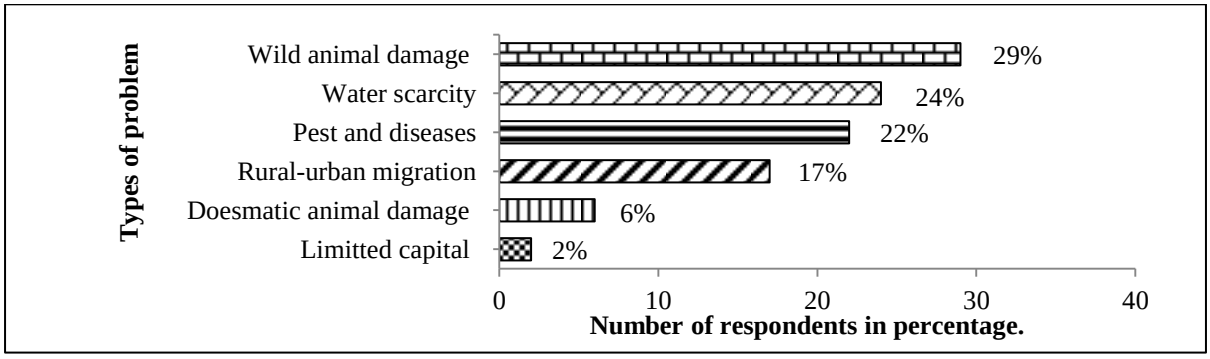

Figure 4. Hazelnut cultivation constraints

4.11 Hazelnut Tree Management Strategies

Management strategies adopted in cultivating hazelnut trees were shown in Figure 5. Majority 32.26% of respondents adopted clearing of weeds as one of the main management strategies. Heading back of dead branches, basin making and pruning were adopted by only 6.45% of the respondents because of limited knowledge and skills. Removal of dead branches and parasitic plants were also adopted by 19.35% and 12.90% of respondents respectively to maintain a healthy growth. A study by Atici (2013) and Fair Labor Association

(2012) also stated the similar management strategies such as adoption of Good Agricultural Practices (GAP) starting from site selection till harvesting would be more convenience in overcoming production problems.

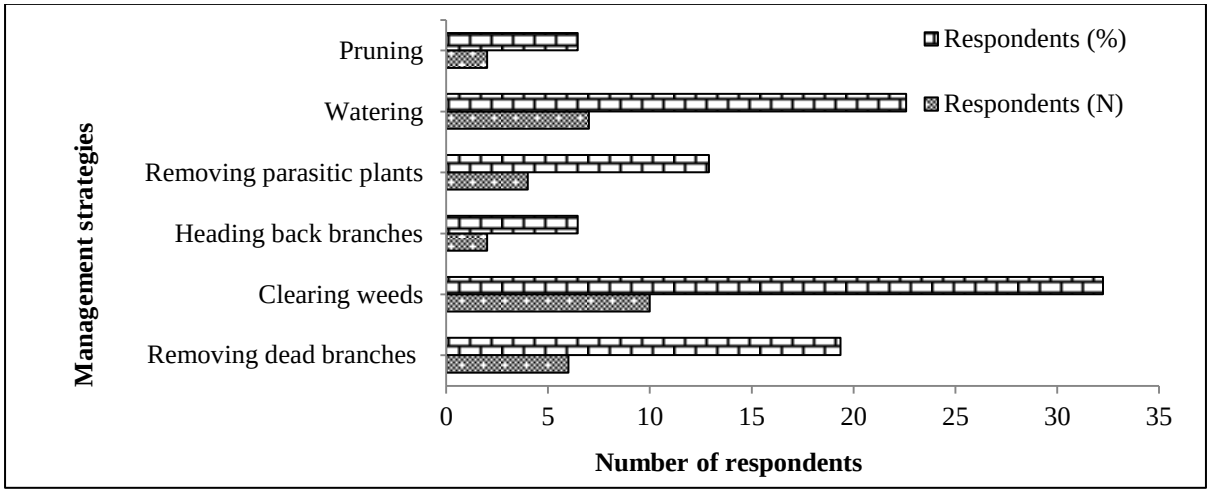

Figure 5. Hazelnut Tree Management Strategies

4.12 Farmers' perception on hazelnut plantation

As shown in Table 7, hazelnut grower's opinion on hazelnut plantation was determined based on their response during field study visit. Among 44 hazelnut growers, 31 of them were selected for interview covering respondents from 5 Chiwogs. During interview 67.74 % farmers turned up responding "Yes" i.e. hazelnut plantation would benefit farmers to generate additional income and strengthen livelihood. Contradictorily, 12.90 % of total hazelnut growers responded "No" which indicated hazelnut plantation wouldn't be beneficial. The 19.35% respondents turned up answering "Don't know". According to the study conducted by Kutateladze *et al.*, (2013), it states that Georgian opinion on hazelnut trees depend on climate suitability, hazelnut varieties and its adaptability. In contradiction, this study found the farmer's responses on hazelnut benefit were based on the current hazelnut tree growth and it also depended on how MHV employees created awareness.

Table 7. Farmers' Opinion on Hazelnut Trees

Hazelnut benefits	**Number of Respondents** (N)	**(%)**
Yes	21	67.74
No	4	12.90
Don't know	6	19.35

5.0 Conclusion

This study found the land use pattern has changed due to introduction of hazelnut trees in Ngatsang Gewog under Mongar Dzongkhag. An average land use increased from 36.86 acres to 44.42 acres. The fallow land and dry land used increased from seven to 28 acres and 75 to 87 acres respectively after hazelnuts. The lands which were used for cultivation of cash crops like maize and potato are now used for hazelnut plantation. A total of 20.89 acres of fallow land and 12.72 acres of dry land were used for hazelnut orchard development. However, it's difficult to draw economic conclusions as crop prices and markets will be different in future but by considering a contract signed between RGoB and MHV and using secondary data maintained by MHV, this study found that after hazelnut introduction an average annual income per households was Nu.55804 which was comparatively profitable than an average annual income per households of Nu 34823 before hazelnuts. Wild animal damage (29%), water scarcity (24%) followed by pest and disease infection (22%) were major constraints that limited healthy hazelnut growth in study site. To overcome the challenges in hazelnut cultivation based on findings a study recommends that MHV needs in-depth study and further research should be done to trace the causes of poor hazelnut tree growth and provide frequent monitoring and extension services.

References

1. Ashoori, D., & Noorhosseini, S. A. (2013). Analysis Using the Delphi Method For Socio_Economic Problems of Hazelnut Growers in Eshkevarat Region in Iran. *Indian Journal of Fundamental and Applied Life Sciences, 3*.

2. Atici, C. (2013). *Food Safety Regulations and Export Responses of Developing Countries:The Case of Turkey's Fig and Hazelnut Exports.* Food and Agriculture Organization of the United Nations.
3. Baldwin, B. (2004). The potential for hazelnut production in Australia. *AFBM Journal* .
4. Berger, p., & Bolte, J. (1997). *Agriculture Land Use.* Willamette River Basin Atlas.
5. Chatterjee, C. S. (2014). *Agricultural value chains in Sub-Saharan Africa.* Germany: Deutsche Bank Research.
6. Christin, S. (2013). *Modernizing Without Westernizing:Transforming Bhutan's Economy with Hazelnuts.* Stanford GSB.
7. Cohoon, B., & Stuckey, M. (2010). *Hybrid HazelnutConsortium.* Oregon State University.
8. Fair Labor Association. (2012). *Assessment of the Hazelnut Supply Chain and Hazelnut Harvest in Turkey.* Turkey: Fair Labor Association.
9. Gol, C., & Dengiz, O. (2007, September 10). Effect of modifying land cover and long-term agricultural practices on the soil characteristics in native forest-land. *Journal of Environmental Biology* .
10. Kutateladze, R., Kochlamazashvili, L., & Kandashvili, S. (2013). Export potential of Georgian hazelnut. *2* (2).
11. Latmahalleh, D. A., & Niyaki, S. A. (2013). Analysis Using the Delphi Method for Socio-Economic Problems of Hazelnut Growers in Eshkevarat Region in Iran. *Indian Journal of Fundamental and Applied Life Sciences* , 515.
12. Lippert, M. (2009). *Hybrid Hazelnuts: Midwest United States Agroforestry Applications.*
13. Marongiu, S. (2005). *An econometrie analysis to evaluate hazelnut price formation on the international hazelnut market.* NSW Department of Primary Industries.
14. National Statistics Bureau. (2013). *Statistical Yearbook of Bhutan 2013.* Thimphu: Royal Government of Bhutan.
15. Olsen, J. (2006). *Hazelnut and walnut production.* Saint Paul: Department of Horticultural Science.
16. Scherr, S., & Stha pit, S. (2009). *Mitigating Climate Change Through Food and Land Use.* Washington: e coag r i culture pa rt ne r s and wor ldwatch ins t i tu t e.
17. Wangchuk, L. (2008). *Facts About Bhutan The land of Thunder Dragon.* Thimphu, Bhutan: Absolute Bhutan Books.
18. Wurtenberger, L., Koellner, T., & Binder, C. R. (2005). *Virtual land use and agricultural trade: Estimating environmental and socio-economic impacts.* Switzerland: Department for Environmental Sciences.