

1. Introduction

1.1 Background

The world presently is over-dependent on a few plant species. The globalization and industrialization of agriculture have made global food security to depend only on a handful of high fertilizer and energy demanding plant species (Mlakar *et al.*, 2010). This increasing problem of global food security is limiting livelihood options for the rural poor, particularly in marginal areas. This effect has raised the demand of only some fertilization and energy high plant species resulting into biased technological development, monoculture production and thus reduced genetic diversity in agriculture. Even if humankind has, over time, used more than 10,000 edible species, today only 150 plant species are commercialized on a significant global scale:- 12 of which provide approximately 80% dietary energy from plants and over 60% of the global requirement for proteins and calories are met by just four species: rice, wheat, maize and potato (FAO, 2005).

The Food and Agriculture Organization (FAO) of the United Nations estimates that demand for food, feed and fiber will rise by 70 per cent in the first half of this century (FAO, 2009). Increasing world population, rising income and urbanization are major driving forces for this food demand (Linehan *et al.*, 2012). Thus, agriculture is under increasing pressure to produce greater quantities of food, feed and bio-fuel on limited land resources for the projected nine billion people on the planet by 2050 (Ebert, 2014). Agricultural production has to increase by 70 % by 2050 to cope with an estimated 40 % increase in world population (Ebert, 2014).

The Asia and Pacific region is one of the most diverse in the world. Some countries, such as Vietnam, Thailand, China, New Zealand regions and Australia, are important exporters of agricultural commodities in the global market. Others are major importers; Philippines, the world's top rice importers. The diverse climates, population sizes, levels of development and agricultural production capacities of the countries in Asia and Pacific make the region extremely vulnerable to risks to food security and food prices (EIU report, 2014). The poor countries such as Bangladesh,

Nepal, Myanmar and Cambodia have some of the highest levels of food insecurity seen around the world.

The overall Asia's food security is improving. On the basis of Global Food Security Index (GFSI), out of 22 nations in Asia, 15 experienced an improvement between 2013 and 2014, while only three—Myanmar, Bangladesh and Vietnam—saw a decline (EIU report, 2014). In general Asia's economic growth is contributing positive towards the improvement in food security. It is also found that region's weakest food security scores are closely correlated to levels of economic development. In Asia's poorer economies, state agricultural Research and Development (R and D) spending is universally below 0.5 % of agricultural Gross Domestic Product (GDP) (EIU report, 2014).

Agriculture is the mainstay of Nepalese economy. The agriculture sector occupies more than 34% share of GDP (NRB 2010 as cited in Prasad *et al.*, 2011). Despite being agricultural country, Nepal has been reliant on food imported from India to feed its growing population since 1990. Nepal does not produce enough food (also food varieties) to satisfy domestic demand (Sapkota, 2011). The production of major staple food like paddy, maize and wheat are insufficient to feed its population for a whole year. It has to import food equal to domestic production deficit. During the negative balance of major food crops, the marginal surplus plays a vital role. In Nepal, the World Food Programme (WFP) argues that about 3.7 million people are at risk of food insecurity (Sapkota, 2011) even though the government maintained that the nation as a whole would have food surplus of about 110,000 tones in fiscal year 2010/11 (TKP, 2011). Still 38 districts in Nepal are having food production deficit.

Imported food is more expensive than food produced locally, because of transport costs. Government's report on soaring food prices indicated that in the short term, the hills and mountains of Far and Mid-western regions are in the biggest threat to food security. For example, average price changes for coarse rice in the Tarai and Hills exceeded those in the Western Mountains; rice was about two to three times more expensive in remote mountain areas compared to other locations (Pyakuryal *et al.*, 2010). Between March 2008 and 2009, food prices rose by 17.1 percent in Nepal (WFP, 2009). In response, the WFP started distributing food to an estimated 23

percent of the population in the most affected areas, and the government-run National Food Corporation (NFC) transported rice to 30 districts at subsidized prices.

Food insecurity and hunger remain pervasive in Nepal, not only in food deficit districts but also within marginalized communities in districts with surplus food production (FAO, 2010). Food and financial crisis is gradually increasing, as the chronic food insecurity since 1990 in Western hills (Adhikari and Bohle, 1999). Food self-sufficiency is mainly related to the production of food, it can also acquire through trade (borrowing and purchasing). Food sufficiency based on production is regarded as principal indicator of food security in developing countries like Nepal. Food self-sufficiency in Nepal is found inconsistent and fluctuating over time (Osmani, 1998 and MoAC, 2005). Therefore, understanding food self-sufficiency is considered to be critical to cope with the problem of food insecurity (Alaimo *et al.*, 1998 as cited in Joshi and Maharjan, 2007).

Cereals in Nepal are crucial from the food security point of view because they form the staple diet of the Nepalese population, providing nearly 69 % of total dietary energy and 63 % of total dietary protein during the period from 2005 to 2007 (FAO, 2010). The key cereal crops are rice, maize, and wheat. These three cereals occupy the major share of cropped area in Nepal, making up more than 75 % of total cultivated area. Rice, the most common crop, accounted for 35 % of total cultivated area and 46 % of total cereal production in 2008/09 (MoAC, 2009). The low productivity and sluggish growth of these three major cereals have been major concerns (IFPRI, 2010) from the economic and poverty alleviation point of view as well as that of food security in Nepal. Besides these cereals, other cereals are generally neglected.

The use of selected number of crops for the global food security and economic growth has placed the future supply of food and rural incomes at risk. These facts with profound environmental consequences and concern for loss of crop varieties has inspired organizations and scientists worldwide in retrieving and researching the knowledge in production and utilization of neglected, disregarded, underexploited and new plant species, or so called alternative crops (Mlakar *et al.*, 2010). Underutilized crops are plant species that are used traditionally for their food, fiber, fodder, oil or medicinal properties (Ebert, 2014). They have an under-exploited potential to

contribute to food security, nutrition, health, income generation and environmental services. These plants are important locally or regionally only, and are known by various names as ‘minor’, ‘neglected’, ‘underexploited’ and ‘orphan’ species, or – our preferred term – as ‘underutilized’ crops.

Neglected or underutilized crops can play essential role to the livelihoods of millions of poor farmers throughout the world. They are also important part of the (threatened) biological assets of the rural poor. Underutilized crops are usually considered in relation to their end-use and end-uses are usually grouped into categories: beverage, cereal, oil, spice, medicines and flavoring, fruit, vegetable, etc (Williams and Haq, 2000). However, the majority of underutilized crops have multipurpose use and they can be grown easily with less external effort in marginal areas of hill and mountain with traditional knowledge where irrigation facility is absent. They are well adapted to the local agro-ecological conditions and tolerate pests and diseases. Moreover, these local crops are known to be “low-input”, mostly requiring no irrigation, no fertilizers, and allowing farmers make productive use of marginal lands (Ebert, 2014, Janick, 1999).

Local species such as barley (*Hordeum vulgare*), buckwheat (*Fagopyrum* spp.), millet (*Eleusine coracana*), amaranth (*Amaranthus viridis*) and sorghum (*Sorghum vulgare*) etc. were once important cereals in the rural areas of hills and mountain of Nepal. Yet, although their advantages are many, most of these local crops are seen as “poor people’s food” – both by the authorities and by consumers themselves. Because of peoples’ preference on imported and commercial food, lack of labor, extension services or information on how to get higher yields, and also difficult to find seeds or propagation material these crops are being neglected.

If properly promoted, however, they have the potential to make a much stronger contribution to the development of poor communities, especially in the context of current and emerging global challenges for agriculture caused by climate change, population growth and other factors. Many underutilized plants have excellent nutritional profiles compared to major crops, with high protein, vitamin and/or mineral contents that can contribute to alleviating ‘hidden hunger’ in better-off as well as low-income communities (Jaenicke and Höschle-Zeledon, 2006). Underutilized

species are also often more amenable than major crops to cultivation in marginal and degraded agricultural environments, providing opportunities to bring neglected land into cultivation and thereby support greater overall food and fuel production (Maxted, 2009). The value of underutilized crops in sustaining cultural richness and maintaining community identity in rural societies through long traditional use should not be neglected (Brush, 2008). In developing countries such as Nepal, promoting these local crops may play crucial role in food sufficiency of marginal people.

Gulmi district of Western Region of the Nepal, comprising of mid-hill and mountain climate has been taken as the study area. Food consumption situation of each household in Western Development Region is “less than adequate” for 20.1 percent, “just adequate” for 72 percent and “more than adequate” for the remaining 4.5 percent (CBS, 2011). Gulmi district is home of 98 % population dependent on agriculture, but 85 % of the population get food from their own production only for 6 months. 5 % of total households are agriculture labor having no land or less than 0.25 to 0.50 ha. land (DDC, 2007).

1.2 Objective of the study

The main goal of the study is to find out the household food self-sufficiency and status of underutilized cereal crops such as millet, buckwheat, barley, amaranth, sorghum. The study has also focused on peoples’ perception and the difficulties towards these crops and their production potentiality. The specific objectives are as follows:

- to assess the household food self-sufficiency
- to find out the status of underutilized crops
- to document farmers’ perception and local knowledge on production and use of underutilized crops

1.3 Statement of the problem

Because of commercialization, agricultural farmers have been gradually shifting toward few market-oriented crops, neglecting many local crops. The political

instability of country with frequent droughts and floods and increasing high food price inflation are the leading factors, to increased vulnerability to food insecurity in the country. This scenario has resulted chronic food shortage in the remote hill districts of Nepal. Food self-sufficiency at household level in developing countries like Nepal resembles the food security status of the household in greater extent. Food self-sufficiency, however in the country is still inconsistent and is fluctuating over time (Osmani, 1998 and MoAC, 2005). More importantly, the overall growth rate of food production in the country has not kept in pace with population growth rate (Maharjan, 2003). Therefore, understanding food self-insufficiency is considered to be critical to cope with the problem of food insecurity (Alaimo *et al.*, 1998 as cited in Joshi and Maharjan, 2007). Diversifying the production with wide range of plant species, including 'underutilized' crops and the use of marginal lands of hills can, therefore, be an alternative to improve the problems. Also these underutilized crops can be grown locally with less or no external input in marginal lands. Therefore, promotion of neglected and underutilized species through research and development could play a crucial role in the food security, income generation and food culture of the rural poor.

Therefore, the research findings will be helpful to find out the status of underutilized crops and food self-sufficiency of marginal people. Hence, promoting local underutilized or neglected crops is essential for the food sufficiency and economic well-being of poor farmers in hills and mountains.

1.4 Limitations of the study

1. The time frame for the research was limited and it covered the annual crops calendar. So, there was no direct observation of crops and was entirely based on the information provided by respondents.
2. This is not a comprehensive study of the region but a case study on limited area within few respondents.
3. Some respondents were found not interested to answer the real answers, so some fact results may be lacking.

2. Literature Review

2.1 Food Security

Food security is defined as the state in which people at all times have physical, social and economic access to sufficient and nutritious food that meets their dietary needs for a healthy and active life, based on the definition established at the 1996 World Food Summit. To achieve food security, food should be available, accessible, and properly utilized at all times. Economic development has the largest impact on food security; there is strong correlation between food affordability and food security (EIU report, 2014). Most of the food secure countries are rich countries with developed economies; have relatively high levels of GDP per capita and low shares of household expenditure on food. These countries have developed infrastructures, including advanced agricultural infrastructures and facilities and systems that support agricultural investment and research and development (R&D), transport infrastructure, including road and port systems, and adequate crop storage facilities that drive food availability (EIU report, 2014).

East and South Asia still represent two-thirds of the world's poorest people and the rural poor are one of the most deprived and widespread categories. Of this many people live in marginal dry upland areas where the dependency of the local population on the various sub-sectors of agriculture, and that on secondary crops in particular, is large. Poor and marginal farmers depend on them as their main source of income as well as staple foods and in times of crisis these crops provide the primary means for food-security and minimizing hunger.

According to the FAO, as of 2004, there were 832 million food-insecure people in developing countries. World is progressing in reducing hunger between 1970 and the mid-1990s. The food-insecure percentage of the population of the developing world had dropped dramatically, from 37% to 16% but still South Asia and Sub-Saharan Africa are home to over three-fifths of all food-insecure people, and form hunger's centre of gravity (EIU report, 2014).

The Table 1, shows the ranking of different regions of the world on the basis of Global Food Security Index, 2014. North America and Europe are the strongest performers in GFSI, dominated by rich countries where as Sub-Saharan Africa has the lowest score.

Table 1: Food Security Ranking/Score Table of All Regions

<i>Overall Rank</i>	<i>Region</i>	<i>2014 GFSI score</i>
1	North America	80.0
2	Europe	75.4
3	Middle East and North Africa	57.4
4	Central and South America	56.0
5	Asia and Pacific	55.0
6	Sub-Saharan Africa	36.1

(Source; Global Food Security Index, 2014)

Poverty and hunger are particularly serious in South Asia and in small islands in the Pacific. Despite, efforts to accelerate economic growth and reduce poverty, only limited progress has been achieved in moving towards the target of halving the number of people who live in hunger by 2015 (the first of the MDG Goals) (Mukherjee, 2008). People in some countries as Afghanistan, China, Bangladesh, DPR Korea, India, Indonesia, Kazakhstan, Nepal, Pakistan, Tajikistan and Uzbekistan, all suffer from hunger in various forms. Also some countries need large scale food aid to minimize hunger and malnutrition.

Nepal is primarily agriculture country providing employment for more than two-third of the population and contributing one-third to the Gross Domestic Product (Anonymous, 2012). The growth in agriculture remains low in Nepal as it is 4.9 percent in 2011/2012 while it was 4.5 percent in 2010/2011 (MoF, 2012). Nepal faces

multiple development challenges, as widespread food insecurity and malnutrition. As a result of rapid population growth, agricultural stagnation and a range of institutional failures, Nepal is facing a serious food crisis.

The 2011 Human Development Index ranks Nepal at 157 out of 187 countries (IFPRI, 2011). 54 % of Nepal's population lives on less than US\$ 1.25 per day, and three and half million people are considered moderately to severe food insecure, counting Nepal among the poorest countries in South Asia (WFP, 2009). In 2009, 15 sub regions of Nepal were developed as sub regional hunger index by WFP indicating the severity of the food insecurity in rural and remote areas. Far-and Mid-Western Hill and Mountain regions were found highest prevalence of hunger. The majority of the fifteen sub-regions of Nepal fall within the *alarming* category with National Hunger Index (NHI) ranging between 20.0 and 29.9. Three sub-regions (Central Hills, Western Hills and Eastern Terai) have NHI between 10.0 and 19.9 indicating a *serious* food insecurity situation. This shows the food security situation is serious in Nepal (WFP, 2009).

The agricultural productivity of Nepal is one of the lowest in the South Asia Region and has been virtually stagnant for over a decade. The situation is even worse in the rural and remote areas of Nepal where food production is barely enough to meet more than six months' demand (CBS, 2011). Due to insufficient food production and limitation of agricultural income farmers are compelled to do other activities for livelihood (FAO, 2010). Hence, this has result the most people in rural and remote area to depend on external/emergency food supply including the WFP. This problem of food insecurity and lack of economic opportunities are the main drivers of out-migration of youth from rural Nepal for employment opportunities and hence, the scarcity of labor force in agriculture in Nepal.

Since 1990, at national level, overall food production is deficit and Nepal has been a net cereal importer for most years during the last two decades (FAO, 2008). Food and financial crisis is gradually increasing, chronic food insecurity since 1990 in Western hills (Adhikari and Bohle, 1999), and total number of food insecure people are 6.9 million (OCHA, 2008). During the mid 1990's Nepal has national food deficit of 14.3% however this varied greatly by region with a 79% in the mountains and a 36% in the Hills, with the Terai region being the only area to produce a surplus, 7 % (Gill,

et al., 2003). The agricultural growth is weak in Nepal compared to other countries in Central Asia, and in recent years, the rate has slowed (MoAC, WFP and FAO, 2009), for example between 1961-63 and 1997- 99 paddy yields in Nepal grew at an annual average rate of 0.6 % compared to 1.41% and 1.43 % in Bangladesh and India respectively (FAO and SAARC, 2008). According the MoAC (2007) estimation the average annual per capita food deficits are 37 kg in the Mountains and 23 kg in the Hills and surplus of 24 kg in Terai, but in aggregate the country remains in deficit (FAO and SAARC, 2008). Main staple food crops in Nepal (rice, maize, wheat and potato) were produced at only 50 percent of maximum attainable yield. Seasonal food shortages are also quite common in many parts of Nepal. Monsoonal influences in production, poor post-harvest storage and handling, and weak transport and market linkage are major reasons for the seasonal food shortage.

Low productivity and lack of agricultural competitiveness are major supporters of Nepal's poverty and food insecurity. According to a detail report on agriculture policy and strategies for poverty alleviation and food security, agriculture poor performance reflects two closely related problems (FAO and UNDP, 2003). First, little arable land so any expansion of cultivated area is either at the expense of forests, or onto low potential marginal lands, also the severe soil erosion, has resulted shrinking average farm size and fragmentation, leading to growing poverty. On the other hand, a heavily reliance on rain fed production (roughly two-thirds of agricultural production is rain fed) and subsistence orientation. Population growth supports these problems by reducing farm sizes over time. According to the MoA report the low investment in irrigation, infrastructure, fertilizers, rural credit and rural power, a heavy reliance on labor, tradition-bound social and economic conditions, and poor markets and marketing systems as well as a lack of research into improving agriculture and very little coordination among government departments are the sources of low yields (Shrestha *et al.*, 2008). As a result of these failures, the annual growth rate of agriculture remains quite low (below 3 %).

Beside various economic sources as services, small-scale manufacturing and tourism in addition to agriculture, the largest share of national income by is derived from agriculture, which provides livelihood for more than 80 percent of the population and

accounts for approximately 40 percent of Gross Domestic Product (FAO/WFP, 2007). Nepal is considered geologically fragile country with frequent soil erosion, results the rise in man/land ratio. It is found that marginal farmers constitute 43 percent of farm households but cultivate just 11 percent of total agricultural land. Official reports indicate that in order to maintain a subsistence living, a family requires somewhat more than one hectare of land in the Mountain districts and half of a hectare in the Hills and Terai; currently, over half the population occupies less than half a hectare (Paudel *et al.*, 2009).

2.2 Food commodity price and demand

Farming is the major source of income for majority of rural population in Nepal, specially located in Mountain region and many parts of Hills and Terai. Nepal Living Standard survey 2004 shows that nearly half of household income comes from agricultural production. The second largest income source is non-farm wages (28 %), followed by remittances (11 %).

The United Nations Organization has recently estimated that more than one billion population in the world is going to be poor in terms of per capita calorie consumption, simply because the peoples have to expend about 40% of income on the food items in their normal food basket (Regmi, 2008).

Ecologically, the Terai, where resided almost half of the country's population, is food surplus area as the granary of the country, while the hills and the mountains are food deficit belts (MOAC, 2007). To fulfill shortage in national food balance, additional supplies through imports or food aids are essential. A deficit in the national supply triggers higher prices for food grains that in turn stimulate food imports especially by private sectors (Regmi, 2008).

Between 1961 and 2002, real food prices declined steadily, with a sharp drop between 1975 and 1985. Beginning in 2002, real food prices began to rise, and by mid-2008 had climbed 64 %. Mainly the price of wheat and maize were triple the level of early 2003, while the price of rice rose fivefold. World market of major food commodities as grains and vegetable oils have been risen sharply more than 60 % above the levels

in recent years (Trostle, 2008). In early 2006, commodity food prices began to rise more quickly. This trend is moving sharply in recent years.

Food demand derives primarily from income growth, population growth and urbanization (Linehan *et al.*, 2012). Urban population in developing countries is expected to more than double between 2007 and 2050, when two-thirds of the developing world 's population will live in urban areas (Linehan *et al.*, 2012). When people move to cities their lifestyles changes and women get higher opportunity costs on their time. As a result, their food habit also shift to foods that require less preparation time (e.g. from sorghum, millet, maize and root crops to rice and wheat), and to more meat, milk, fruit, vegetables and processed foods. Developed countries are likely to remain the key global suppliers of coarse grains, while Asian developing countries will meet much of the demand for imported rice (FAO, 2008).

This rise in food price doesn't depend on a single factor. Many factors contributed to these price increases. Long-term trends that led to rise in food price are slower growth in production and rapid growth in demand (Trostle, 2008). Various other factors are further responsible to tightened world markets include rising energy prices, biofuel production, income, globalization, land and water constraints, under investment in rural infrastructure and agricultural innovation, lack of access to inputs and weather disruptions.

Nepal has been largely affected by the food crisis of 2007. The GHI 2011 shows that fewer people are available to work on the farms, and most of the young people are migrating to foreign countries to work. "That is why agricultural labor is not sufficient, so that some of the farm land may lie fallow. Hence, the agricultural production is lower than before, and prices are rising." Rice is the major crop under cultivation as well as the predominant staple in the Nepali diet. The IFPRI's estimates show that the large growth in the direct demand for rice is driven mainly by the high growth in population between now and 2030 and not so much by a rise in per capita consumption (Kathmandu Post, Jan 20, 2012).

Domestically, food prices are fast outstripping than other prices. Since, sufficient food is not produced in Nepal, it has to import food equal to domestic production deficit.

So, shocks in production, supply and prices of agricultural goods at the global level affect food prices in local markets as well. Generally, in Nepal prices for staple foods are strongly dependent on corresponding prices in Indian markets. From 2004 to 2007, prices for rice in the Mountain region were on average 177 percent higher than for the markets in the Terai region and were 123 percent higher than in the Eastern region (FAO/WFP, 2007). There was 316,000 metric tons food deficit in 2010, an increase by 139 percent from 2009, according to the WFP.

Table 2: Ratio in Percentage of Total Agricultural Import

	2008/09	2009/10	2010/11	2011/12
Share of Ag. Import on total Import	14.2	11.8	13.7	15.3
Share of cereals import on total Agricultural Import	5.3	9.4	9.2	17.6
Share of rice import on total cereal imports	80.8	54.3	39.1	42.9
Share of rice import on total agricultural Import	4.3	5.1	3.6	7.6

Source: Nepal Foreign Trade Statistics, 2008/09-2011/12, Trade and Export Promotion Centre, Kathmandu Nepal.

It is found that a Nepali spends, on average, 59 percent of his/her income on food. Of this about 58 percent and 15 percent are spent on breads and cereals, and fruits and vegetables, respectively (Republica, 22 Feb 2011). Additionally, households located in the Mountain regions spent as much as 65 percent of their income on food, compared with a national average of 37 % (FAO/WFP, 2007). Food price is already very high, further rise in food price in domestic market will result more people to take low quality and less quantity of food, which will directly affect the health of poor and marginalized people.

2.3 Underutilized Crops

Plants are the basis for the human food supply, either consumed directly or fed to animal intermediaries. Through a long sequence of trial and error, a relatively few

plant species have become the mainstay of present day agriculture (Janick, 1999). Today in world the three major cereal crops (wheat, rice and maize) provide more than half of the world's total food requirements, this has narrowed the number of species upon which global food security depends. Due to the commercial advantages of mono cropping and the high yield of many improved hybrids crops, crop varieties- typified by local, traditional crop varieties and minor crops- is being neglected (Padulosi *et al.*, 2013).

Underutilized species were once more widely grown but are falling into disuse due to various agronomic, genetic, economic and cultural factors. Agricultural species that are not among the major staple crops often come under the heading of 'neglected and underutilized species' (NUS) and are sometimes called 'orphan' crops (Padulosi *et al.*, 2013). Typically, these crops are not treated as commodities. Role played by underutilized crops are many; as alternative food, source of incomes, food security and nutrition, and for combating the 'hidden hunger' caused by micronutrient (vitamin and mineral) deficiencies, strongly linked to the cultural heritage and their places of origin, adapted to specific agro-ecological niches and marginal land and so on. Underutilized or neglected crops can ensure sustainable production and improve livelihood of poor farmers. It is reported that minor millets in India, due to short biological cycle and an efficient root system, have a comparative advantage where water is scarce and rainfall is low (Padulosi *et al.*, 2009). In India, for example, adding value to little millet enhanced farmers' incomes three-fold and generated employment in villages – particularly for women. This also enhanced women's social status and self-esteem (Vijayalakshmi *et al.*, 2010). In Ecuador, production of amaranth increased by 180 % and sales by 115 %. This raised the annual income of producers involved in the pilot projects by 20 % (Padulosi *et al.*, 2013). Secondary crops have the potential to contribute, as sources of raw materials in industries, uses as fresh and dried foods. These secondary crops are cheap and appropriate source of renewable material. Hence, this potential is another advantage to alleviate local poverty. Apart from their strategic role as staple for the poor in marginal agricultural regions, they are also assuming a new role as a health food for the urban high income people.

There has been a general neglect of agricultural research in recent decades; underutilized crops in particular have received little investment from research institutions and development agencies (World Bank, 2007). These Underutilized crops are the lesser known species in terms of trade and research, and often adapted to marginal and stress conditions (Joshi *et al.*, 2002). Beside their multiple uses, their commercial importance and market value is still unknown to majority of the people. They are being devalued and graded as low grade food item in Nepal due to the wrong and narrow perception of the people. Thus, their presence in the Nepalese food item is declining over the years. The major reasons for this decline is the increased availability of rice, wheat, maize and other commercial food items and also the changing lifestyle, people's thinking and taste preference. The lack of modern technologies for their effective processing and utilization is another important reason for their declining. These crops tend to be managed with traditional systems, use informal seed sources and their processing can be laborious, primitive and products marketed locally with limited involvement of large enterprises. All these elements have collectively contributed to the neglect and underutilization of these crops leading to their increased marginalization, loss of their genetic diversity and traditional food culture associated with them. This neglect is also causing the marginalization of farmers who have been traditionally depending on these crops for their food security and income.

The challenge is thus, to make the value added and promote these crops for the benefit of rural poor through appropriate strategies and policies. The time for action on underutilized crops is now. It is necessary to continue and improve the successful measures and further increase productivity, quality and demand for these crops. As the national average yield of these crops is still very low and their local cultivars were found susceptible to several diseases, it is important to continue the improved varieties including research on hybrids. The awareness programmes of their beneficial qualities, such as its nutritional value, role in food security and livelihood of marginal people is needed. In order to enhance the emerging business of value-added their products, supply chain management is vital, which should be facilitated by government organizations responsible for agricultural market promotion. Promoting of these underutilized crops in niche markets through denomination of origin (DO), eco-labeling, fair trade, organic and Slow Food initiatives are particularly useful.

3. Materials and Methods

3.1 Study Area

The field study was carried out in Hastichaur VDC, located in Gulmi district of Lumbini zone in Western development region of Nepal (Figure 1). According to the administrative division of Nepal, Gulmi is divided into 79 VDCs with district headquarter Tamghas. The total land area of the district is 1149 sq. Km. The district is bordered by Baglung to the North, Pyuthan to the West, Palpa and Arghakhachi to the South and Parbat and Syangja to the East. It covers an area which stretches East to West from 27 degree 55' to 28 degree 27' longitude and in North to South latitude from 83 degree 10' to 83 degree 35'. The district, East to North is 40 Km. and North to South width is 30 Km. According to the CBS (2011), the total population of this district is 280,160. The male population is 120,995 and the female population is 159,165. The sex ratio is 76. The total number of households is 64,921 and the average household size is 4.32. The population density of the district is 244 per square kilometer. The annual population growth rate is -0.57 %. The economically active population of the district is 61.3 % with literacy rate 72.6 %. Total agricultural land is 21,182.61 hectares in which 25.41 % land is irrigated. Of the total land of district, 50.2 % is agricultural land, 11.8 % grazing land, 37.6 % forest and shrub land, 0.4 % landslide area and others (sand, concrete, rocks) 0.7 % (Nepal, 2003 as cited in Acharya, 2012).

Hastichaur VDC comprises 1,552 households and 6,901 total populations with household size 4.45 (CBS, 2011). Total 2857 are male and 4026 are female with sex ratio 71.41. The major caste and ethnic people are Brahmin (514), Chhetri (2,864), Magar (668), Kumal (1,130), Dalit (1,289) and other (436).

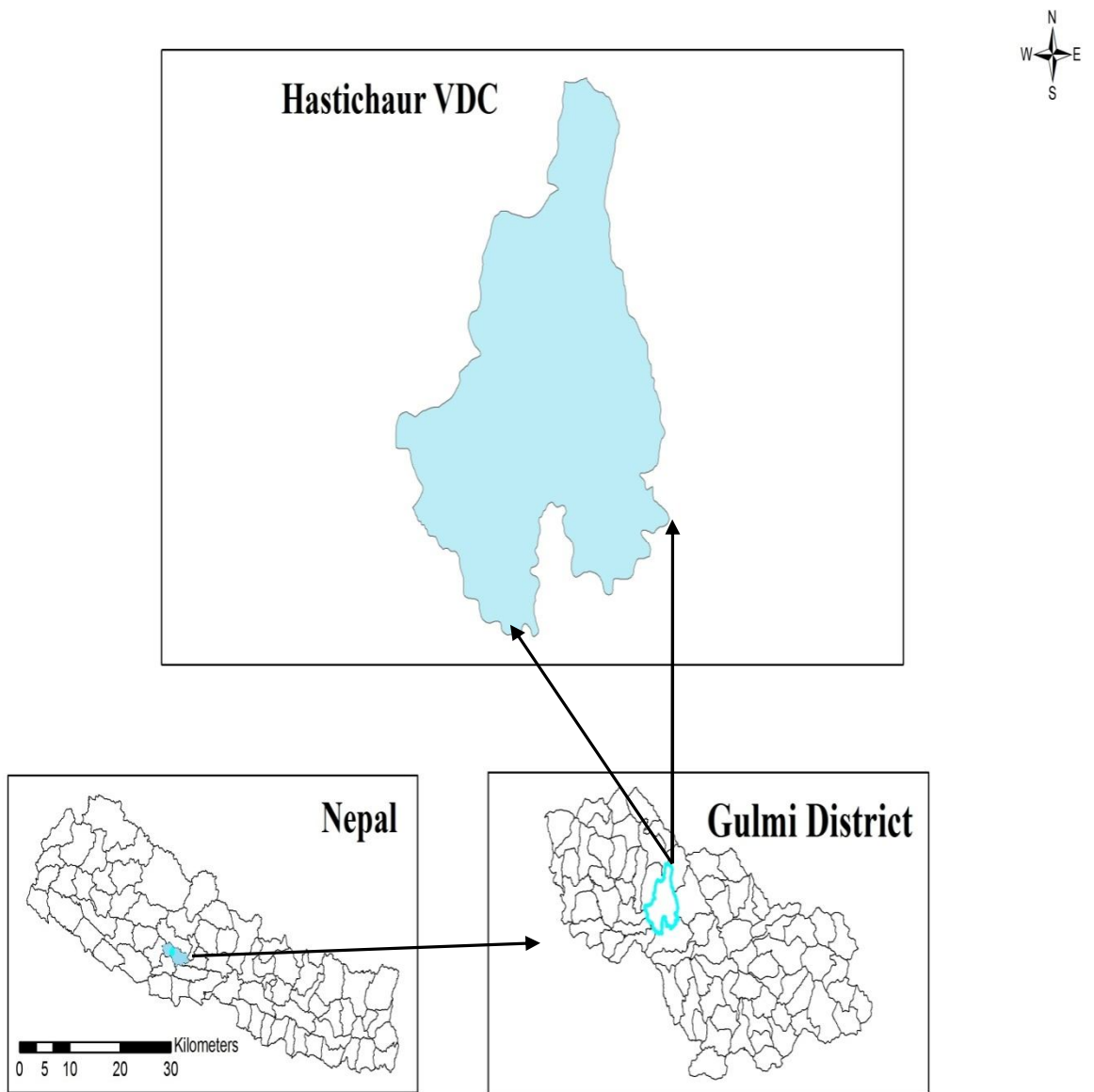
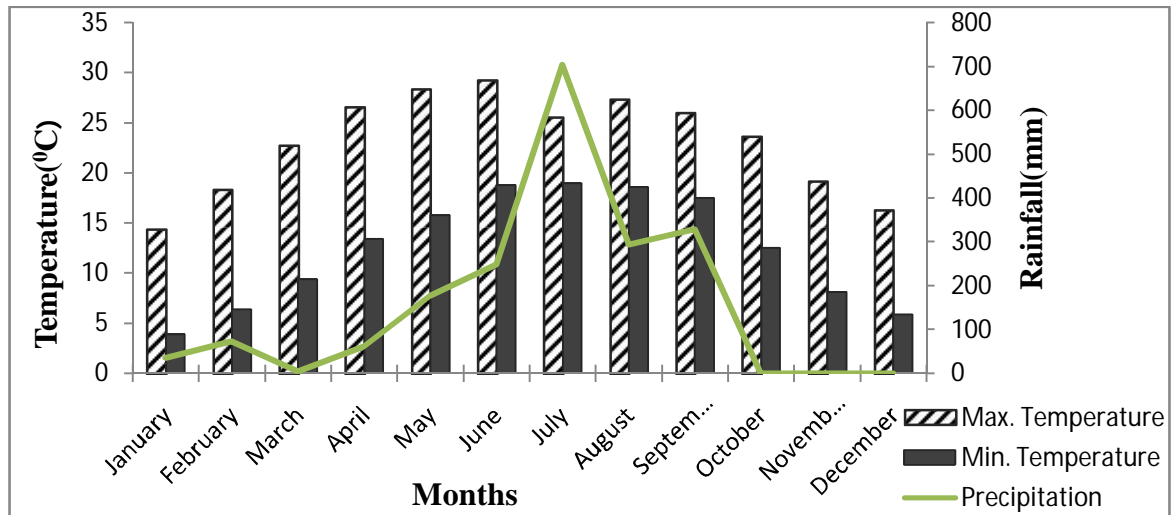


Figure 1: Map of Hastichaur VDC, Gulmi

3.1.1 Climate of the Study Area

According to the climatic data of Tamghas (DHM, 2012), the average minimum temperature was 12.44°C and average maximum temperature was 23.18°C. The average precipitation was 160.27 mm (millimeter).



(Source: Department of Hydrology and Meteorology (DHM), Babarmahal, Kathmandu).

Figure 2: Temperature and Precipitation of Tamghas Station, Gulmi District of the Year 2012.

The district is dominated by ridges interspersed with river valleys. The elevation ranges from 610 to 3050 metres. The district has tropical to temperate type with cool and humid climate. The average maximum temperature is 26°C and minimum 4.1°C. The average annual rainfall is about 1939 mm (GoN, 2008, as cited in Acharya, 2012). The common vegetations found in the study area were *Schima-Castanopsis*, *Pinus roxburghii*, *Quercus semecarpifolia*, *Rhododendron arboreum*. The principal agricultural products of Gulmi district are coffee, ginger and orange. Gulmi is also known as pioneer district in the production of coffee.

3.2 Data Collection Method

Primary and secondary data collection techniques have been applied. Both qualitative and quantitative methods and tools were employed for this study. Household was taken as the sampling unit. Total 71 household were surveyed. Stratified random sampling was used on the basis of ethnicity of the community. Proportion of different

ethnic group households were selected on the basis of total population in each ethnic group. Semi-structured questionnaires were prepared as research tools for interview schedule for the household survey. The questionnaires had been designed at household level to collect information on socioeconomic profile, total crops production, household food sufficiency, and status of underutilized crops, agriculture practices and production and use pattern and perception of local on these crops.

3.2.1 Sources of secondary data

Required information for the present study was acquired through the review of relevant literature from national and international publications, authorized documents, information obtained from related field of Governmental Organizations, Websites, articles, published and unpublished books, journals , newspaper, etc.

3.2.2 Sources of primary data

a) Household Survey

With prepared questionnaires, household survey was conducted. Total 71 household were asked.

b) Focus group discussion

Focus group discussion was conducted (3 focus group discussions was done in study area with the involvement of 8-10 participants) with involvement and representation of all stakeholders.

c) Key Informant interviews

Key informant interviews were taken from lead farmers, social workers, schools teachers, VDC secretaries and representatives of Agriculture Service Center and District Agriculture Development Office.

3.3 Food Self-sufficiency

Data on socioeconomic characteristics, food production and utilization, food self-sufficiency, reasons for food self-insufficiency and means to fulfill deficit were collected from household survey. Food self sufficiency was measured through total calorie available for consumption to households from their own farm production, requirement based on adult equivalent and calorie requirements for hill (Joshi and Maharjan, 2007). The major food crops namely paddy, maize, wheat and millet were

taken in to consideration for the estimation of calorie availability (CBS, 2003). The basic standard calorie requirement of 2344 Kcal/person/day (CBS, 2003) in the Hills was considered for the study. It is estimated that 87.3 % of this calorie is generally available from the food crops (Gautam, 1993). The food crops requirement thus, was estimated at 2046.3 Kcal/person/day for Hills. Therefore, food self-sufficiency was calculated based on the food crop requirement and available from self-production (Joshi and Maharjan, 2007 and Bhandari, 2012).

$$\text{Calorie available (CA)} = a_1 X_{\text{paddy}} + a_2 \text{maize} + a_3 \text{wheat} + a_4 \text{millet} \dots\dots\dots 1$$

Where,

CA= calorie available

X= Conversion factor from paddy to rice i. e. 0.6175

a_1 =calorie conversion factor of rice i.e. 345 Kcal per 100 gm

a_2 = calorie conversion factor of maize i.e. 342Kcal per 100 gm

a_3 =calorie conversion factor of wheat i.e. 346 Kcal per 100 gm

a_4 = calorie conversion factor of millet i.e. 309 Kcal per 100 gm

$$\text{Monthly Calorie requirement (MCR)} = \text{Scr} \times 0.873 \times \text{family size} \times 30 \text{ days} \dots\dots\dots 2$$

Where, MCR= monthly calorie requirement

Scr = standard calorie requirement for hills i.e. 2344 Kcal/person/day

Family size= average family size in the study area (adult equivalent)

Food Self-sufficiency (FSS) is simply calculated dividing calorie available by average monthly calorie requirement.

$$\text{Food Self-sufficiency months (FSS)} = \text{CA/MCR} \dots\dots\dots 3$$

3.4 Data Processing and Analysis

The collected data from both secondary and primary sources were edited, coded and tabulated in the appropriate formats in Microsoft Office Excel 2007. Some local terms of measurements were converted into standard measurement terms. After processing, according to the objective of the study data were analyzed and interpreted in descriptive and analytical methods. Simple frequency tables, pie chart, bar diagram, cross tabulation are used as analytical tools of this study. The SPSS-16 version was used to analyze data with chi-square test. GIS technique was used to prepare map of the study area.

4. Results

4.1 Socio-economic Factors Affecting Food Security in the Study Area

4.1.1 Population and Ethnicity

The sampled household size was 71. Out of total respondents, 50.70 % were male and 49.30 % were female (Figure 3.1). Among the age group of the respondents 25.35 % were less than 35 years, 50.94 % were between 35-55 years and 23.94 % were above 55 years.

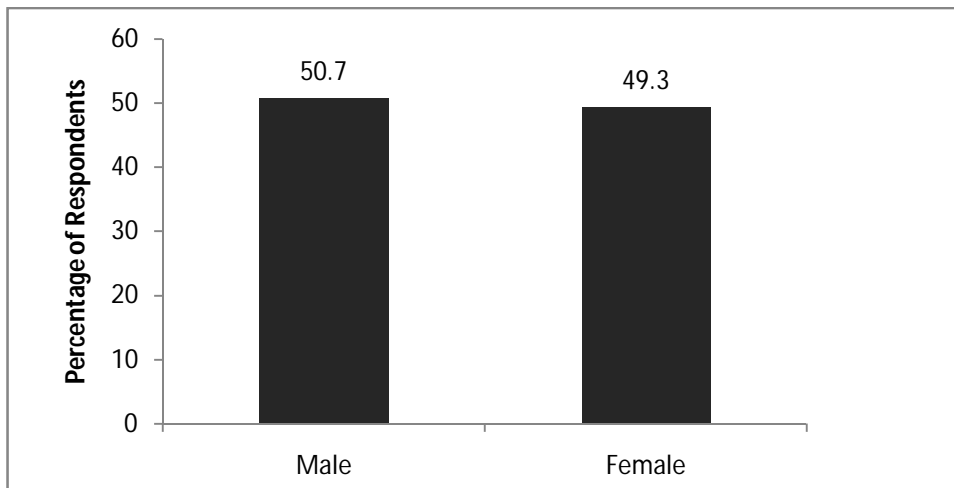


Figure 3.1: Sex Composition of Respondents

The Respondents caste ethnicity was dominated by hill high caste, Brahmin and Chhetri. The hill ethnic caste Magar was less in comparison to Dalits and Kumal (Figure 3.2).

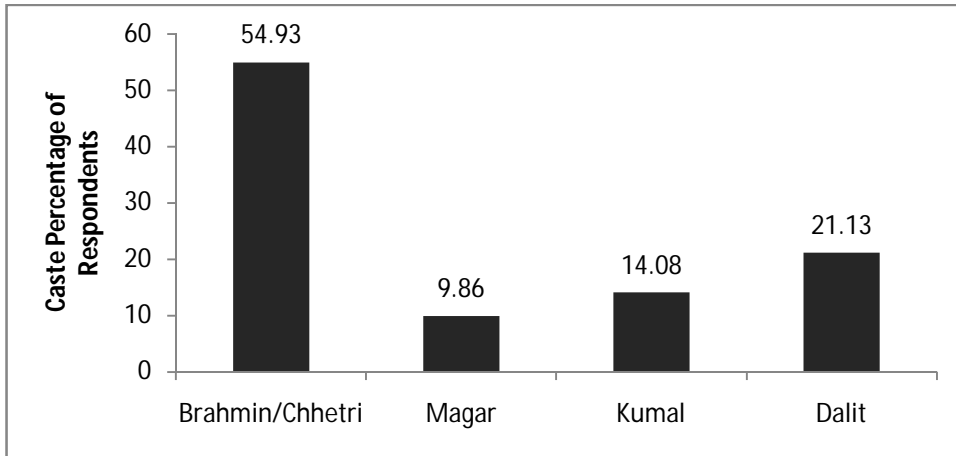


Figure 3.2: Ethnicity of Respondents

4.1.2 Family Size

The average family size was 7.08 per household. Out of total respondents, majority of them have medium size family (5-10 members) followed by small (up to 5 members) and large family (more than 10 members) (Figure 4).

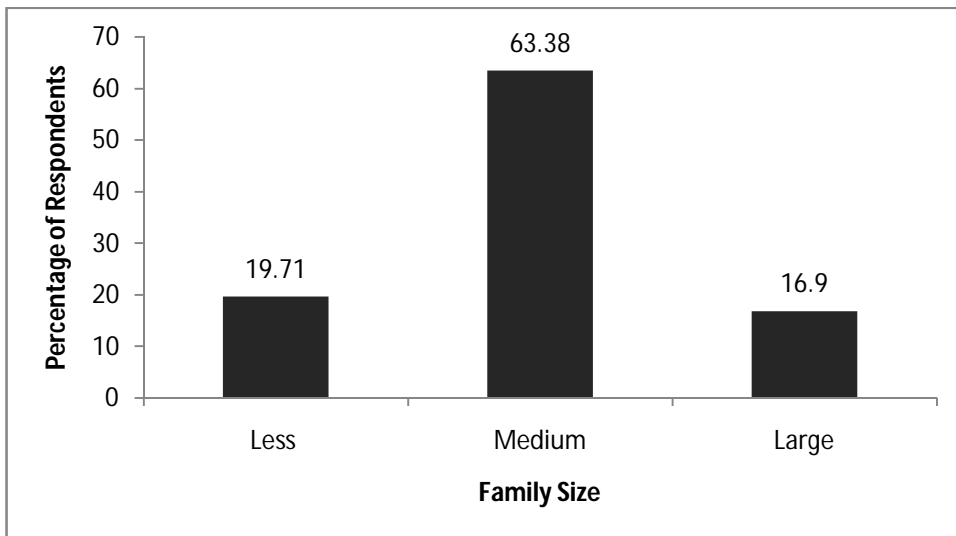


Figure 4: Family Size of Respondents

4.1.3 Literacy Rate

The education level of respondents was categorized into four groups. Respondents who did not know how to read and write were classified as 'Illiterate', below 10 class 'literate', up to Bachelor 'Educated' and above bachelor 'Well Educated'. The study revealed that majority the respondents were literate followed by illiterate and educated. Very few respondents were found well educated (Figure 5).

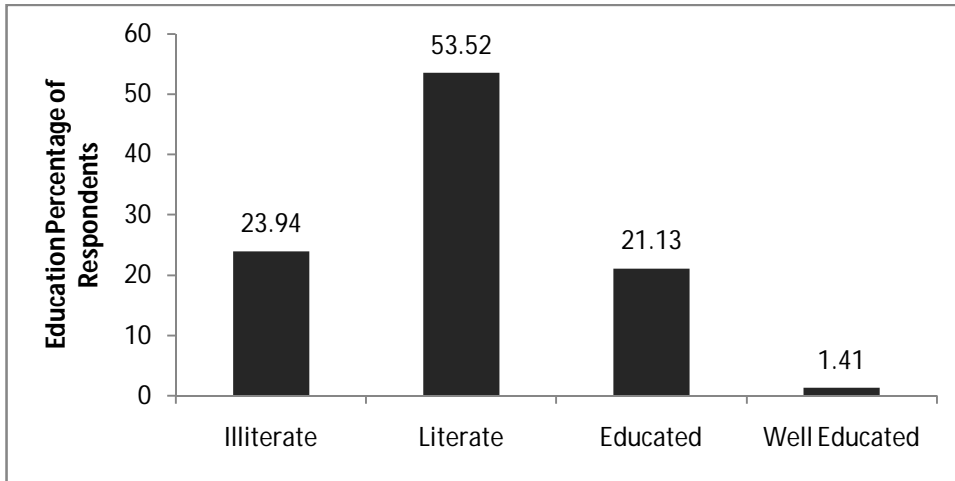


Figure 5: Literacy Rate of Respondents

4.1.4 Occupational Status

More than half of respondents were dependent on agriculture i.e. 64.79 %. The other category with 15.49 % includes pensioners, social workers, physically inactive or disable or differently able, politician. Besides farming many of the respondents were found engage in business and jobs followed by labor and foreign workers (Figure 6).

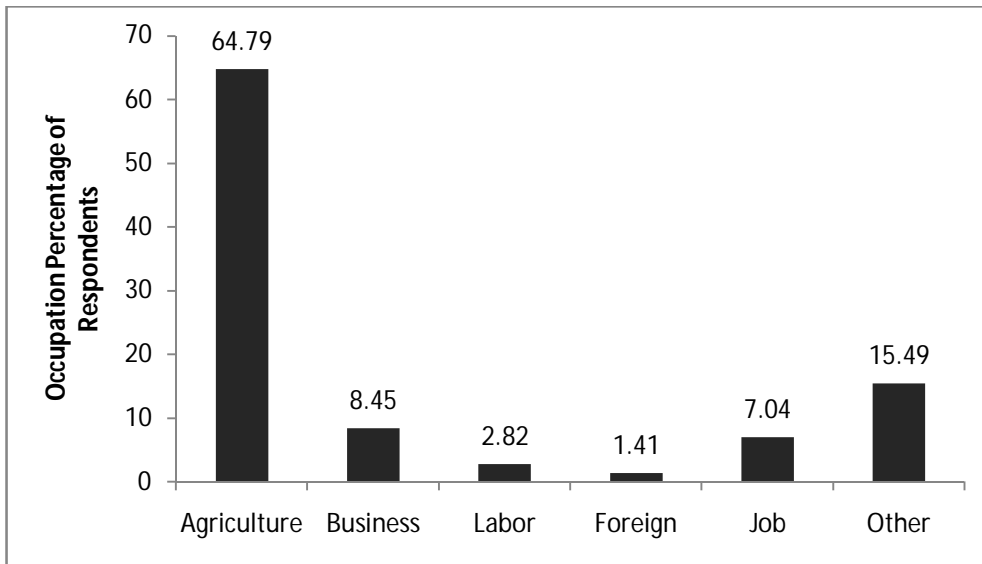


Figure 6: Occupation of Respondents

4.1.5 Landholdings

A recent rough estimate by WFP stated that the minimum amount of land required for a household self-sufficiency is approximately 0.54 ha (OCHA, 2008). The land category in the study consists of Khet (Irrigated land), Bari and Khoriyan (non-irrigated land). Most of the respondents who were interviewed have their own land. Very few were landless. The landholdings were categorized into 3-groups as small (<0.5 ha.), medium (0.5-2 ha.), and large (>2 ha.), adopting government standard criteria. From the analysis, it was found that the study area is dominated by small land owners including 2.82 % landless, followed by medium land owners and large land owners (Figure 7.1).

Of total 55.18 ha. land high portion of land was Khoriyan than Bari and Khet only 9.95 ha. (Figure 7.2). Mostly Khet were in lower area near riverside. Some respondents won only Bari and rice is more preferred in all households. So, such household have to spend large amount on imported rice.

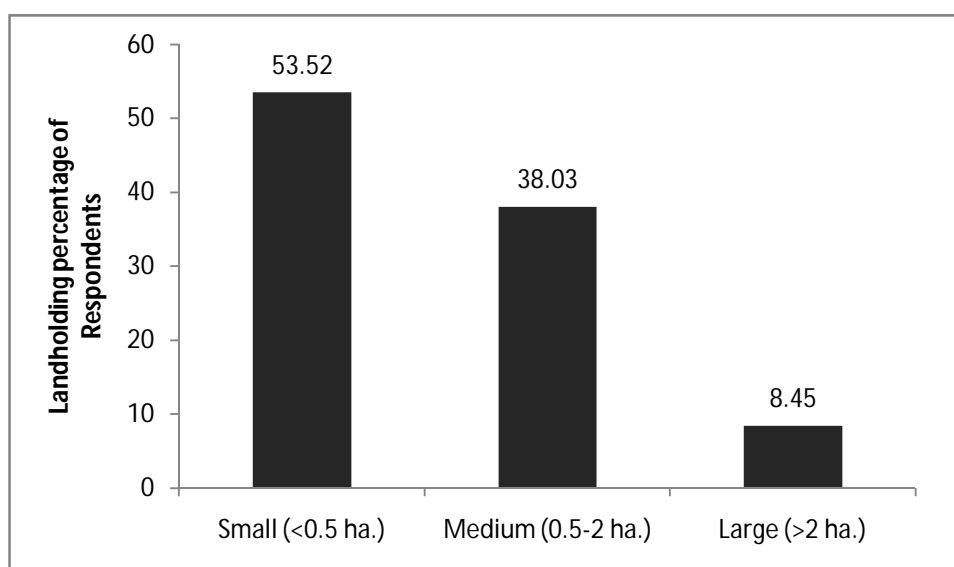


Figure 7.1: landholding Status of Respondents in Hectare (ha.)

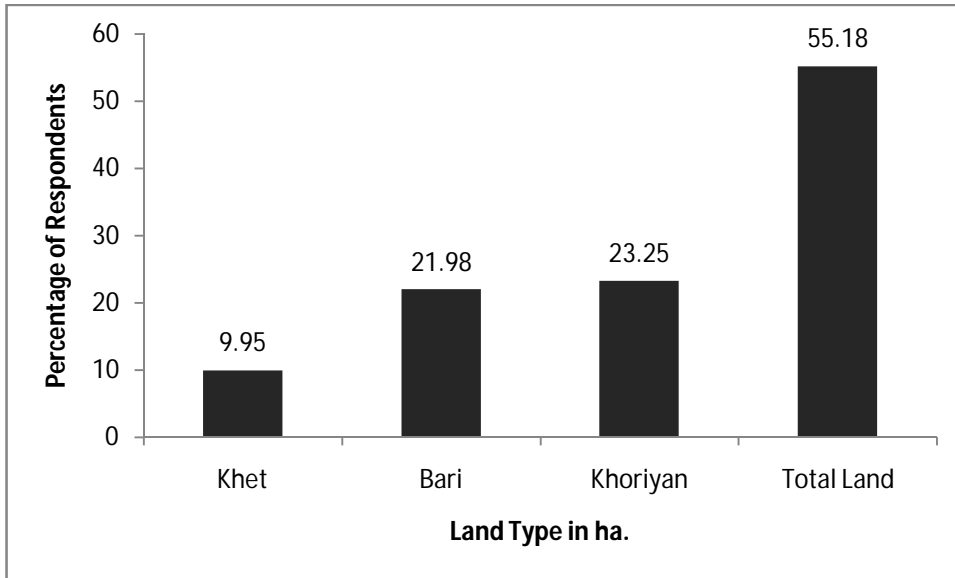


Figure 7.2: Land type in Study Area

4.2 Total Production of Cereal Crops

Figure 8, shows the total cereal crop production in the study area. Here the maize is produced in the highest amount followed by millet, then rice, wheat, barley and so on.

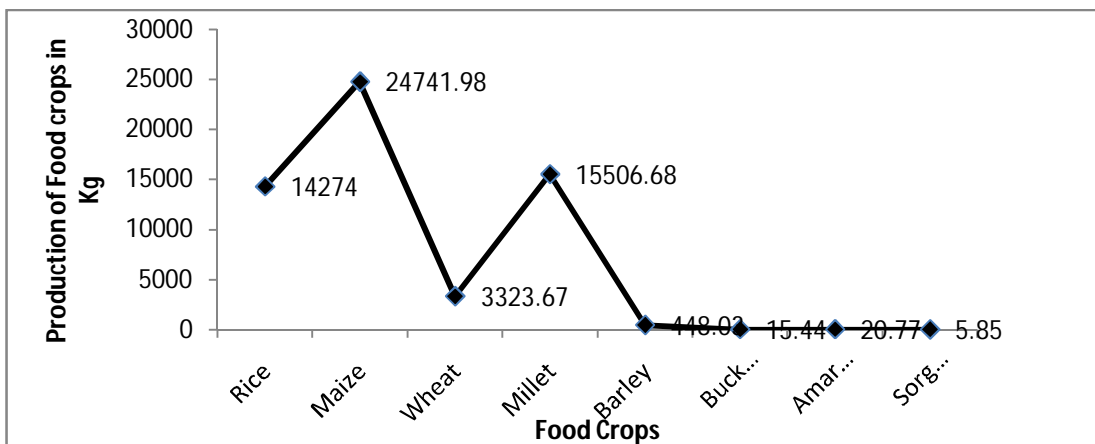


Figure 8: Total Cereal Crops Production in Hastichaur VDC

From the field survey, the percentage occupied by underutilized crops as millet was 26.58 %, barley 0.77 % and buckwheat 0.03 % of the total cereal production in study area. The production of amaranth and sorghum was found to be very low (just for own use in a very low quantity), so their production was not measurable. Here, the millet occupies second highest percentage (then maize), of the total cereal production in VDC (Table 3).

Table 3: Percentage Occupied by Underutilized Crops in Total Cereal Production.

S.N.	Name of Crops	Production of Underutilized Crops in mt. and percentage occupied by these crops in total cereal production					
		Nepal (2011/12)		Gulmi District (2011/12)		Hastichaur VDC (by field study)	
		Production	Occupied %	Production	Occupied %	Production	Occupied %
1	Millet	315067	3.33	2863.5	2.95	15.51	26.58
2	Barley	34830	0.37	555	0.57	6.53	0.77
3	Buckwheat	10021	0.11	325	0.34	0.22	0.03
4	Amaranth	Data not available				Not measurable	
5	Sorghum	Data not available				Not measurable	

(Source: Statistical information on Nepalese Agriculture 2011/12 and Field survey)

4.3 Food Security Status

4.3.1 Food Self-sufficiency Percentage of Household

From the direct interview, majority of the respondents seems to have food self-sufficient below six months from their own production. Figure 9, shows many respondents have food self-sufficiency for up to 3 months only where as very few respondents were found food self-sufficient and food surplus.

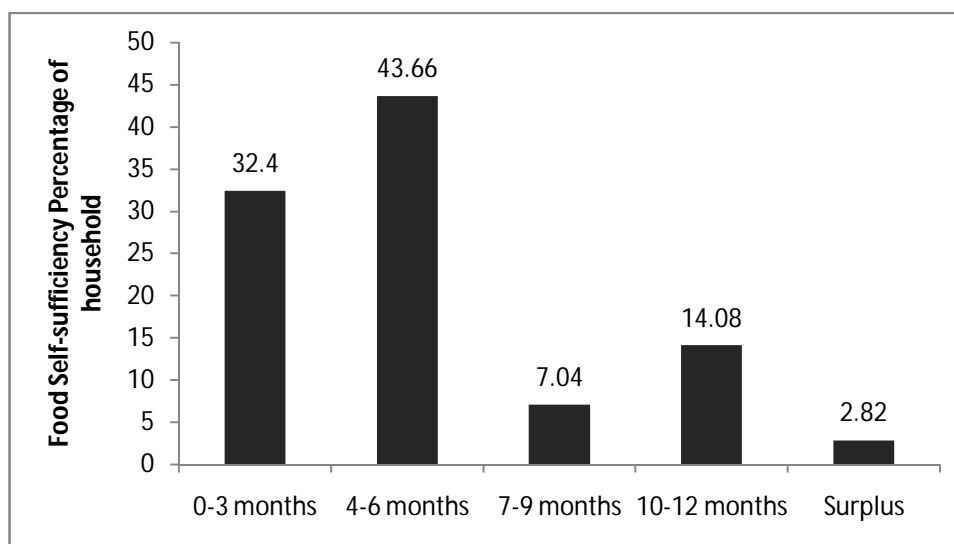


Figure 9: Food Self-sufficiency Percentage of Household

4.3.2 Food Self-sufficiency On the Basis of Calorie available

Similarly, the food self-sufficiency was also calculated based in the calorie available from the crop produced on own farm and required adult equivalent calorie. The average food self-sufficiency by this method was 5.65 months (Table 4).

Table 4: Average Food Self-sufficiency Based on Annual Crop Harvest and Calorie Demand

S.N.	Parameters	Value
1	Average HH paddy harvest (Kg)	201.04
2	Average HH rice harvest (Kg)	124.14
3	Average HH maize harvest (Kg)	348.48
4	Average HH wheat harvest (Kg)	46.81
5	Average HH millet harvest (Kg)	218.40
6	Calorie available from rice/HH (Kcal)	428293.9
7	Calorie available from maize/HH (Kcal)	1191797
8	Calorie available from wheat/HH (Kcal)	161970.4
9	Calorie available from millet/HH (Kcal)	67868.1
10	Total calorie from four crops/HH (Kcal)	2456929.2
11	Basic standard calorie requirement in hills (Kcal/person/day)	2344
12	Food crop calorie requirement in hills (Kcal/person/day)	2046.3
13	Food crop calorie requirement (Kcal/person/month)	434882.23
14	Average family size	7.08
15	Mean adult equivalent conversion factor	0.87
16	Adult equivalent family size	6.18
17	Average self-sufficiency of food (months)	5.65

4.3.3 Average Food Import Price

In the study area, the highest import of food item was of rice that is worth about NRs. 26,967.46 in average (Figure 10). Rice is followed by maize, wheat and other items. Besides these major crops other minor crops are not purchased, if in a very low amount.

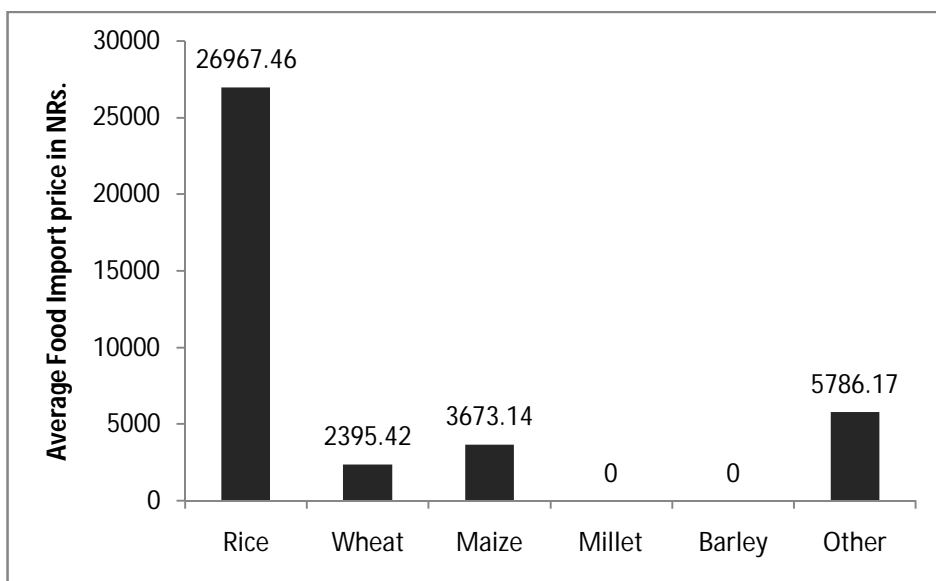


Figure 10: Average food purchase price in NRs

4.3.5 Food Self-sufficiency of the respondents and use of Underutilized crops in the study area

From the chi-square test between food sufficiency and underutilized crops with various affecting factors, the following results were obtained (Table 5). Less landholding was one of the factors affecting household food self-sufficiency. There was a significant relation ($p < 0.001$) between land size and household food self-sufficiency. Family size was also another significant factor for food insufficiency ($p < 0.001$). Larger the family size, lower the food sufficiency from their own production. There was also significant relation between caste and occupation with food self-sufficiency ($p = 0.036$) and ($p < 0.001$) respectively. With the decrease in use and production of underutilized crops, food sufficiency was also found low ($p = 0.005$). But there was no relation between family size and the use and production of underutilized crops ($p = 0.309$).

Table 5: Food Self-sufficiency of the Respondents and Use of Underutilized Crops in the Study Area

	Yes (%)	No (%)	X^2	p -value
<i>Land size and food sufficiency</i>				
Less than 0.5 ha.	4.23	49.30	2.00	<0.001
0.5-2 ha.	7.04	30.98		
More than 2 ha.	5.63	2.82		
<i>Family size and food sufficiency</i>				
Up to 5 members	8.45	9.86	22.98	<0.001
6-10 members	7.04	56.34		
Above 10 members	1.41	15.49		
<i>Caste and food sufficiency</i>				
Brahmin/Chhetri	14.41	40.85	8.56	0.036
Magar	1.41	8.45		
Kumal	1.41	12.68		
Dalit	0	21.13		
<i>Occupation and food sufficiency</i>				
Agriculture	2.82	31.24	22.53	<0.001
Business	5.63	2.82		
Labor	0	2.82		
Job and foreign	5.63	2.82		
Other	2.82	12.68		
<i>Use/production of underutilized crops and food sufficiency</i>				
Increasing	1.41	1.41	10.47	0.005
Decreasing	8.45	70.42		
Same/no idea	7.04	11.27		
<i>Family size and increase in use/production of underutilized crops</i>				
Up to 5 members	8.45	35.21	2.35	0.309
6-10 members	2.82	36.62		
Above 10 members	2.82	14.08		

4.4 Activities during Food Shortage

During food shortage, most of the respondents in Hastichaur VDC get engaged in various off farm activities; some are assisted from others or borrow money (Figure 11). 12.68 % respondents are engaged in two or more activities.

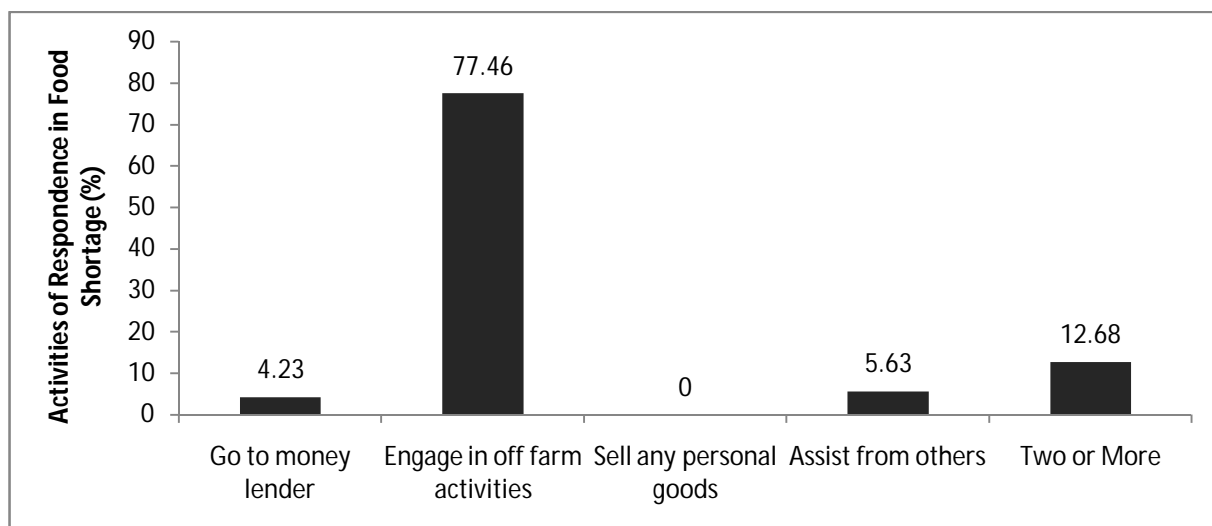


Figure 11: Activities during Food Shortage

4.5 People's Perception on Utilization and Production rate of Underutilized crops

Respondents were asked their views on utilization and production of underutilized crops, most of the respondents told decreasing, some answered same or no idea and very few respondents answered increasing (Figure 12). This result shows that the production and utilization of these crops is decreasing. Most of the respondents were interested towards commercial crops cultivation as vegetables, fruits, spices.

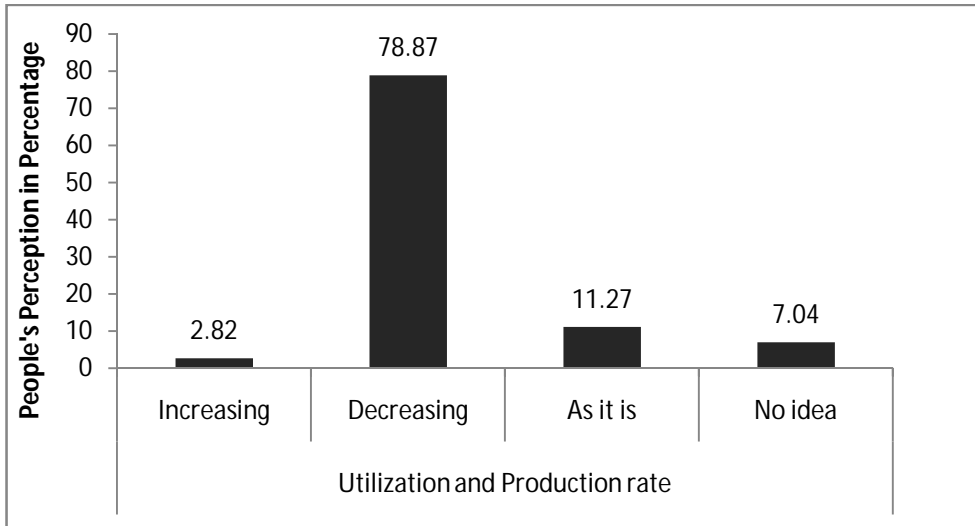


Figure 12: People's Perception in Utilization and Production of Underutilized Crops

4.6 Agricultural Input Status in Study Area

4.6.1 Percentage of Household using Compost Manure

4.23 % respondents don't use compost manure in recent time where it was 8.45 % some years ago. The number of respondents using higher amount of compost manure are decreasing (Figure 13).

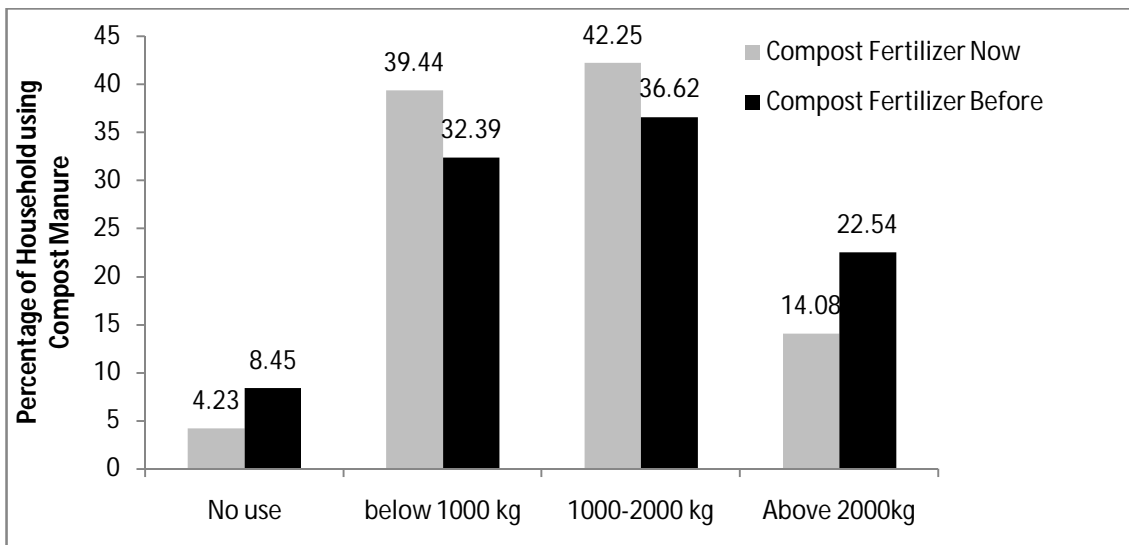


Figure 13: Percentage of Household Using Compost Manure, Now and Before in Kg

4.6.2 Percentage of Household using Chemical Fertilizer

The number of respondents using chemical fertilizer is increasing. Of total respondent asked, 73.24 % told that before some years they don't used to use chemical fertilizer in their field but it has decreased to 45.07 % in recent years. Figure 14, shows the percentage of respondents using the quantity of chemical fertilizer.

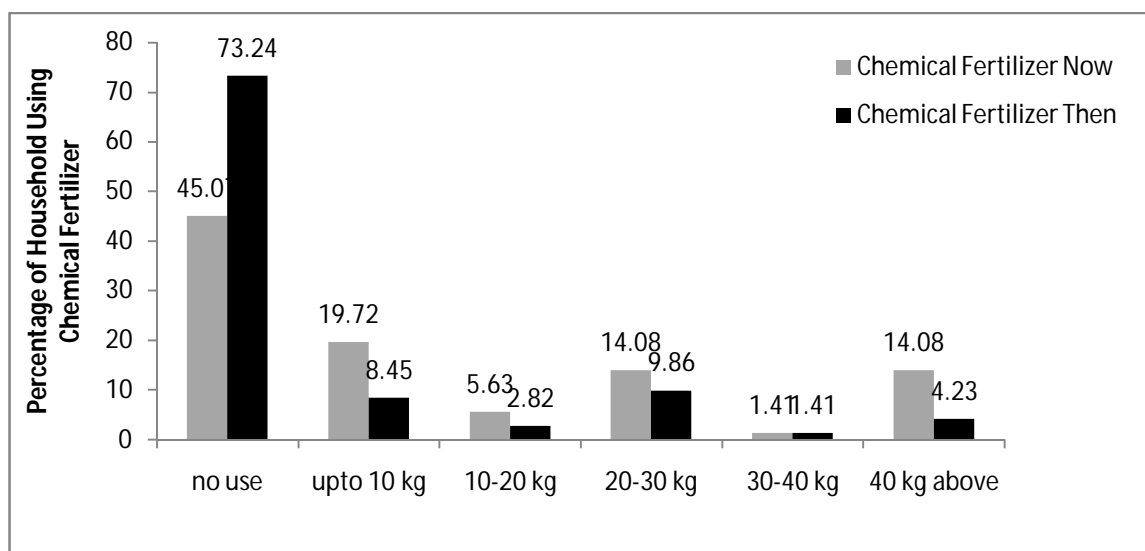


Figure 14: Percentage of Household Using Chemical Fertilizer, Now and Then in Kg

4.6.3 Percentage of Household Using Pesticides

In recent days some respondents found using pesticides in their crops, but most of the respondents use local methods to get rid of various plant diseases or do nothing. Some respondents answered during weeding time, they select the infected plant or part and withdraw from the field. Only 8.45% respondents were found using pesticides where 25.35% respondents found using local methods and most of the respondents found doing nothing during disease (Figure 15).

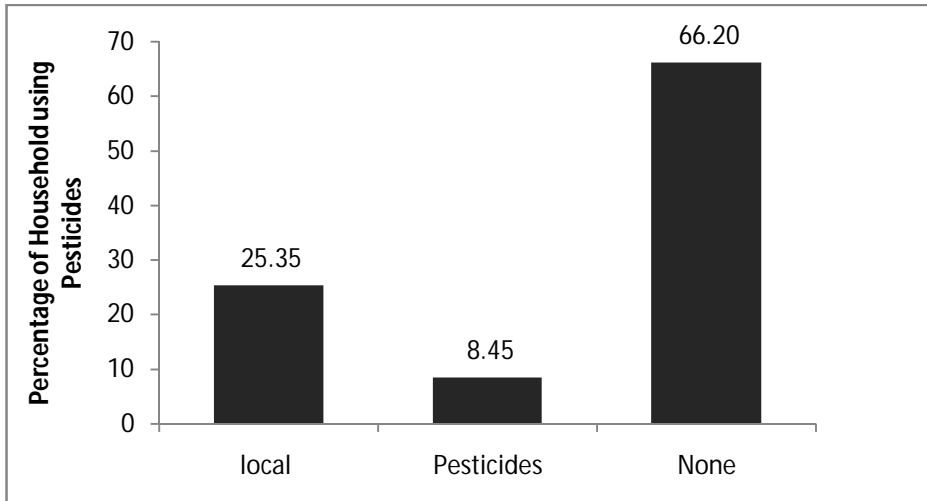


Figure 15: Percentage of Household Using Pesticides

4.6.4 Technology and Irrigation Status

Almost all the respondents answered that they are following traditional methods for cultivation of crops. Local and traditional equipments are used for ploughing, digging and so on.

The irrigation status is very poor in the study area. Most of the land was rain fed; there is only slight progress in irrigation system. 47.89 % respondents depend on rainwater for irrigation which was 46.48 % before (Figure 16). 39.44 % respondents irrigate through traditional canals which was 46.48 % before, 5.63 % irrigate through cemented canals, 1.41 % through pipelines and 5.63 % through both traditional and pipeline.

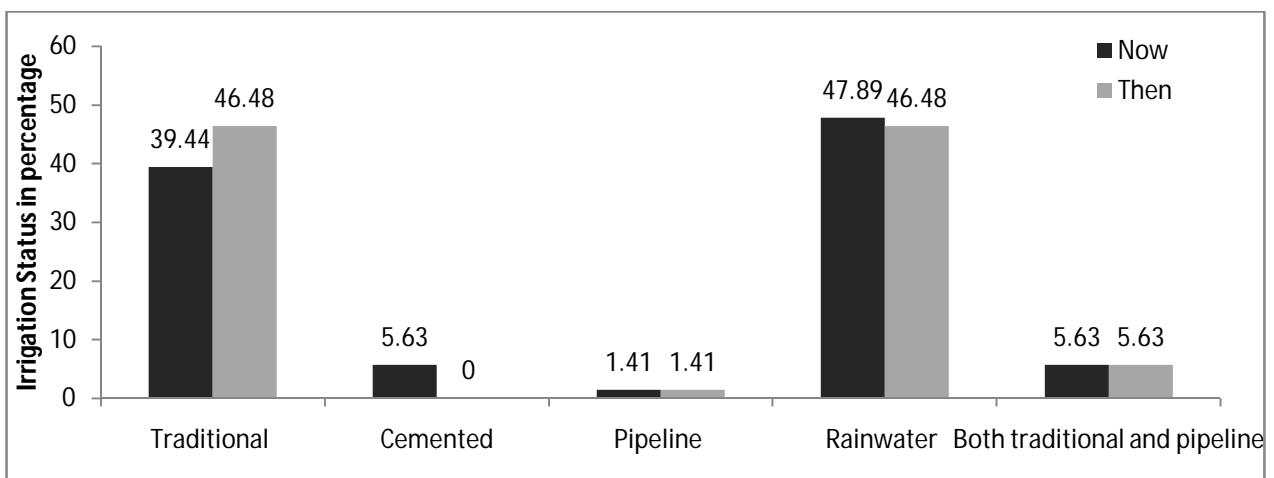


Figure 16: Irrigation Status in Study Area

4.7 Causes of Decrease in Underutilized Crops

Majority of the respondent's perception toward causes of decreasing underutilized crops was due to changing food preferences while 19.4 % told their harvesting is tedious and difficult, while few respondents answered reduce in their production and lack of labor (Figure 17).

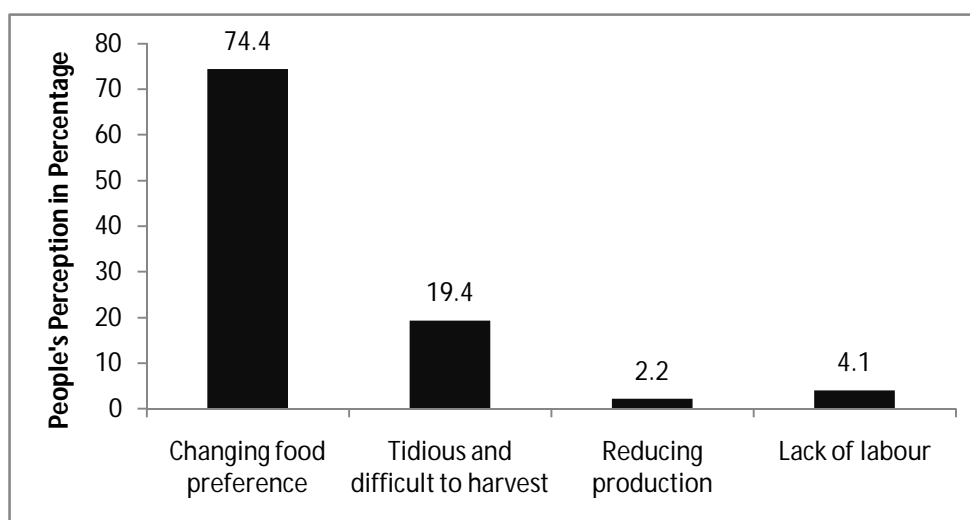


Figure 17: People's Perception in Decrease in Underutilized Crops

4.7.2 Problems in cultivation

Respondents have various views on the problems on agriculture (Figure 18). Among various problems irrigation affected the crop most than hailstorm, animals and wind.

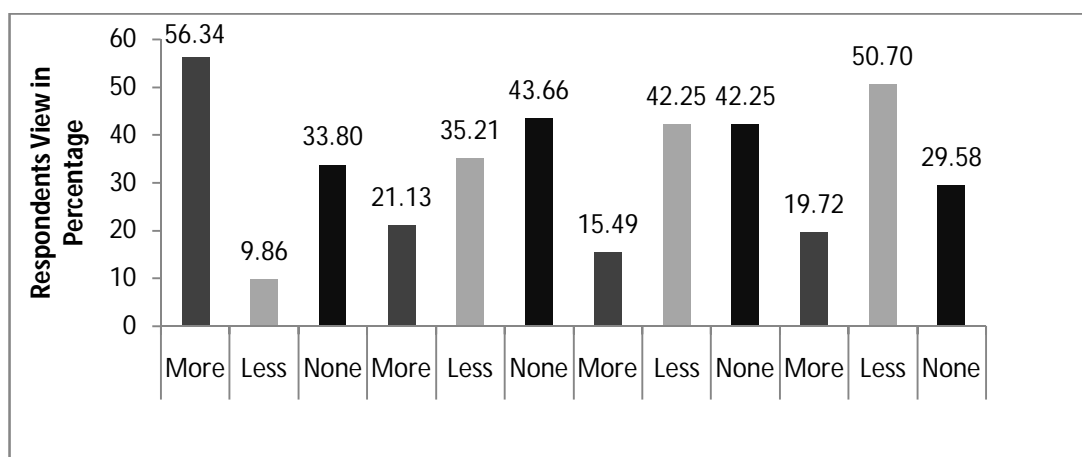


Figure 18: Problems in Cultivation of Underutilized crops

4.8 Crop Calendar of Underutilized Crops

Table 6: Crop Calendar of Underutilized Crops

S. N.	Name of crops	Months											
		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1	Millet		1	3	2	3		5	5	6			
2	Buckwheat						2			5	6		
3	Barley	6					2					5	6
4	Amaranth			2	2			5	6				
5	Sorghum	2	2						5	5	6		

(Indices: 1-Bedding, 2-Planting, 3- Weeding, 4-Irrigation, 5-Harvesting and 6-Grain Processing)

The crop calendar of these underutilized crops is shown in Table 6. Most of these crops are planted in rain fed land without irrigation. All the agronomy practices are completely traditional and manual based weeding in all marginalized crops. The study shows that these underutilized crops are highly labor intensive in comparison to profit. Therefore, the farmers have less interest in the cultivation of these crops.

4.9 Uses of these underutilized crops

Underutilized crops are utilized for various purposes. Major uses and nutritional value of selected species of are given in the Table 7. Since the cultures and rituals are handed down from generation to generation, traditional knowledge is also transmitted in the same way. Such knowledge and importance are needed to be studied and documented.

Table 7: Uses of Listed Underutilized Crops

S.N.	Name of species	Nutritional value	Uses
1.	Millet (<i>Paspalum scrobiculatum</i>); Nepali-Kodo	High micronutrient content, particularly calcium and iron, dietary fibre, essential amino acids and low glycemic index	Dhido, Bread (roti), Tai roti (pan cake), Rakshi (local wine), fodder, some medicinal use
2.	Barley (<i>Hordeum vulgare</i>); Nepali- Jau	Starch, dietary fibre, and crude protein	Dhido, Shell Roti, roti (Daal roti), Tai roti (pan cake), Phuraula, Batuk, satu, fodder, medicine for cold cough, fever, gastritis, stomach problems, headache, alcoholic and non-alcoholic beverage,
3	Buckwheat (<i>Fagopyrum</i> spp.); Nepali- Phaper	proteins, polysaccharides, dietary fibre, lipids, rutin, polyphenols, micro- and macroelements	Satu, Roti (Bread) Haluwa, Dhido, Lito for children, Religious value, Rakshi (local wine), fodder
4.	Amaranthus (<i>Amaranthus viridis</i>); Nepali- Latte	Essential micronutrients such as b-carotene, iron, calcium, vitamin C and folic acid	Green leaves as vegetable. Tender stem as drum- stick in curry. Sweet porridge, Halwa, Roti, Paratha, Pakoras, Cattle feed.
5.	Sorghum (<i>Sorghum vulgare</i>); Nepali- Junelo	Carbohydrate, protein and vitamin-B	Food, fodder, alcoholic and non-alcoholic beverage

5. Discussion

Food security means people have access to sufficient, safe and nutritious food to meet the dietary needs for active and healthy life (FAO, 1996). Today the world depends upon very limited species. The use of selected number of species and the low productivity in agriculture is a major contributor to poverty and food insecurity. The problem of food insecurity is more supported with the blind imitation of modern lifestyle; many traditional mountain foods are being neglected as “foods of the poor”. Relatively cheap, high-fat, high-sugar products, such as sugary drinks, processed meats and white bread, have more demand, even if their nutritional value is very low.

5.1 Socio-economic Status and Food Security

From the study, male and female respondents were approximately equal with 50.70 % of male and 49.30 % were female. Brahmin/ Chhetri were dominant ethnic (59.93 %) caste followed by Dalits, Kumal and Magars. Majority of Brahmin and Chhetri were found food self-sufficient in the study area compared to other caste which is in accordance with the results of Joshi and Maharjan, (2007). The average family size was 7.08 per household. It is remarkably higher than the national average of 4.88. Majority (63.38 %) of household had 5-10 members in their family which is little more than the findings of Joshi and Maharjan (2007) i.e. 56 %. This shows, with the increase in family size, there was decrease in food sufficiency. As majority of respondents were found having small land size so with the increase in family size, their household food insufficiency also increases. Education is crucial for adoption of any improved technology in agriculture, which ultimately aids to food self-sufficiency (Joshi and Maharjan, 2007). Most of the household (53.52 %) were literate in comparison to 23.94 % illiterate other was educated and well educated. Agriculture was most dominant occupation with 64.79 %. According to Nepal Demographic and Health Survey (NDHS) 2006, around 84 percent people residing in the rural areas live with limited education and skills and a little chance of opportunities for non-agricultural employment (GoN, 2007). This indicate that still agriculture remain important source of livelihood for majority of people in rural area. More than 80 % of the population in Nepal is engaged in agriculture which is second largest contributor (36.2 %) to GDP (Economic Survey, 2010/11). Most of the respondents who were engaged in Business and job were more food secured than other as farmer and labor.

Small size farm was dominating that is less than 0.5 ha. about 53.52 % of respondents were found having land size less than 0.5 ha, followed by medium and large. In an average a farm house in hills need 0.52 ha of land to be able to produce enough food (NPC, 2010 cited in MoAC, 2012). The study shows that the average landholding is 0.77ha which is smaller in comparison to national average of 0.8 ha (CBS, 2003). And the landholding frequency is clustered below 0.5 ha. The size of land holdings clearly showed the uneven distribution of land (0-5.55 ha), which directly relates the food sufficiency of low land holding category respondents. Most of respondents with less land below 0.5 ha were found food insufficient. Also there was a significant relation between land size and food sufficiency, thus we can say that small land size was one of the major factor responsible for household food insufficiency. Also with the decrease in use and production of underutilized crops the food sufficiency was found low.

In the study with the attainment of higher education, the involvement of respondent in agriculture was found declining. And most of the people who are illiterate, they don't have other options than to depend on agriculture and labor. It was also found that most of the respondents showed little interest towards agriculture and express their desire to leave this field as soon as they find opportunity in service and so on. In the study mainly women and children were found engage in agriculture, where the male and younger members were found engage in other economical activities.

5.2 Production of Food Crops and Food Self-sufficiency Status

Of the major cereal production in Nepal, paddy comprises the highest yield followed by maize and wheat. Millet and barley comprises very low production where as buckwheat is negligible. As we see the national trend of cereal production from 1990/91 to 2011/12, the production of major Crops as rice, maize and wheat are in increasing order where as that of minor crops as Millet, Buckwheat and Barley are not progressive. On the basis of 'Statistical Information on Nepalese Agriculture, 2011/12', the national and district production of millet, barley and buckwheat was very low of total cereal production. This clearly shows that, though the hill and mountain region of our country has large potential to grow these marginal crops but

their production is not expected in comparison to the major crops. These local crops are adapted to the marginal land of our hill and mountain region but due to various reasons we are neglecting them and growing other commercial crops on those lands that have created low production of these crops. Hence, it directly affects the food self-sufficiency and livelihood of marginal farmers.

The figure 8, shows that the production of local crops as maize and millet was the highest in the study area than rice and wheat. The yield of paddy (1,434.57 kg/ha) and maize (1,125.91 kg/ha) in the study area was below the yield of Gulmi district. Similarly, the yield of millet was slightly lower than the Gulmi district, where as that of wheat, barley and buckwheat in the study area was very lower than the yield of district. This low yield of crops as compared to the average yield of the district may be due to the less landholding supported by climatic variability, land structure and soil quality, lack of irrigation and advance agriculture technology. It was also found that more millet, buckwheat and barley were cultivated before but left in these days because of lack of manpower and interest in these crops. The yield of amaranth and sorghum was very low (not measurable) and very rarely found only in some house in study area, this shows that these crops are being disappear.

Food self-sufficiency is one of the important determinants of food security and can be used to assess the food security situation in household level (Joshi and Maharjan, 2007). In the study area rice, wheat, maize and millet was produced in large amount. From the direct interview and on the basis of production of food crops in own farm that is available for consumption, food self-sufficiency was measured. Food self-sufficiency situation was found poor in study area. Farmer's interest towards cash crops in Eastern Development Region and small size of land holding in Far Western Development Region lead to food self-insufficiency (Joshi and Maharjan, 2007). The food self-sufficiency by direct interview shows majority of the respondents (43.66%) has food up to 6 months only where as very few respondents have food sufficient for 12 months and more. 32.40% have food sufficiency below 3 months (including landless respondents), which is very high in comparison to the result 4.4% in an average of Joshi and Maharjan (2007). And the average food self-sufficiency on the basis of calorie demand and available calorie from own farm production was found 5.65 months. This may be because the study area being a remote part of hill district, majority of landholding was small with high marginal land and no irrigation facility.

The food sufficiency was significantly related with land size, family size, caste and use and production of underutilized crops. Also the overall low production and interest towards cash crops are other reasons. Many respondents were found interested towards vegetables, other crops as coffee, ginger, spices, fruits and so on. This shift in cultivation in cash crops from food crops created threats to self-sufficiency with increasing dependency in market (Joshi and Maharjan, 2007). Also some amount of their crop production as maize and millet is given to their animal husbandry and most of the local production of millet is used to produce local beverage for their sell and use.

5.3 Status of Underutilized Crops

Among total cereal production the role of the underutilized crops is crucial in marginal areas. Millet occupies 26.58 % of total cereal production in study area which is very high in comparison to national production that is 3.33 % and 2.95 % of the Gulmi district. The millet occupies higher percentage than that of rice (24.47 %) in total production in study area. barley and buckwheat occupies slightly more percentage than district in study area. This is because these local species are more adapted to these marginal areas as they don't need more irrigation facility and other agricultural inputs. Thus, cultivating of underutilized species like millet, barley, buckwheat in marginal areas is more beneficial than other crops. And as a whole in district the cultivation of these marginal crops may be lower than other main crops so their occupied percentage is very low in total cereal production.

The respondents were found less interested towards the use and production of local varieties. They were more interested towards imported food items as polished rice and processed wheat flour so large quantity of food is imported. The production of millet is higher than rice in study area but treating them as low graded food and changed food preference, mostly these crops are used for animal and to produce local beverage or sold hence to buy rice.

These underutilized crops are treated as 'food for poor' so beside food they use these crops for other secondary uses depending highly on imported food (rice and wheat) as staple food. 78.87 % of respondents answered that the use and production of these

underutilized crops is decreasing. While investigating about the perception of farmers about the causes of decreasing production of these underutilized crops most of the respondents (74.4 %) answered change in food preference, 19.45 % answered tedious and difficult to harvest followed by lack of labor and low production. These crops are mainly being neglected and treated as low valued crops. Instead of cultivating these underutilized crops most people would prefer to cultivate commercial food items and prefer to buy from accessible market by engaging in off farm activities. It is also found that the majority of respondent use local seed and less agriculture inputs for cultivation of underutilized crop while for major crop they use more agricultural inputs and certified seeds. The study area is characterized by remote and scattered farms as well as poor means of communication and transport. The persistent lack of connectivity and market link is another factor leading to the marginalization of these underutilized crops.

5.4 Resolving Food Self-insufficiency

Engaging in off farm activities, borrowing and assisting from other and buying preferred food from market are the methods to fulfill the food demand. Among the major cereal import, rice, maize and wheat play important role. Of the total cereal import in the study area, 81.63 % of amount is spend to purchase rice as compared to national 66.98 % (for rice and paddy) where as 11.12 % amount for maize and 7.25 % for wheat in study area and that is 32.66 % and 0.35 % respectively in country. The trend of importing cereal is increasing. If we see the national trend of importing food crops, we can see the national import of rice is the highest among other cereals. From the year 2008/09 to 2011/12 the average import value of rice is the highest which is followed by maize and wheat (Nepal Foreign Trade Statistics).

From the study it was found that the respondents were more interested towards imported food items and don't purchase any amount of underutilized crops. Also they told that some years ago these crops were paid to workers as wage but now days the workers don't like to take these crops as wage, instead they ask for cash or rice and other things. This is because the production of rice is low but the demand is high. In the study area, most of the land is rain fed upland (Bari) in comparison to irrigated land (Khet). Rice is grown only in irrigated land with more agricultural input which is low in the study area so its production is also low, but its preference is high. The local

crops as maize, millet, barley are adapted to rain fed marginal area, so their production is high but the preference is low. Thus, large amount is spent on rice. This clearly shows that we are highly depending on polished rice or other imported food items neglecting our local food crops.

5.5 People's Perception in Agriculture Problems

Beside change in food habits of the respondents irrigation is other major problem. National with almost 65% of agricultural land is rain fed and annual agricultural output is highly dependent on weather conditions (Regmi, 2008). Here in the study area also most of the portion of cultivable land was Bari and Khoriya, which is rain fed. Thus, still for irrigation 47.89% of respondents depend on rain water and 39.44% on traditional canals. In present days very few people use cemented canals and pipeline. The use of compost manure is decreasing in comparison to previous year, as the number of livestock is decreasing and some respondents were found using chemical fertilizers. The respondents also accept that the condition of disease is increasing. Some of the common diseases were *Sete*, which consume chlorophyll of the plant, stem borer- *Gobaro* insects in maize, Blight-which affect the leaf of plant and red ants mainly for potatoes and some insects. Very few people were found to use pesticides mainly in vegetables. 25.35% of the respondents answered they use local medicines as ashes, kerosene, urine of cow, etc. and most of the respondents found doing nothing in disease.

5.6 Importance of Underutilized Crops and their Potentiality

It is found that beside food, underutilized species as millet, buckwheat, barley, amaranth and sorghum have different uses values in the study areas. Among them barley and sorghum are used in religious value. Millet is found to make local alcohol as well as its products are widely used when suffered from cold. The straw of millet is used as nutritious forage for cattle. It is found that millet and buckwheat is used in medicinal propose by the respondent in the study area but other species as amaranth, barley and sorghum are not found to be used in medicinal propose by the respondents. Sorghum is thought to make land unfertile by the respondent so they cultivate it on the marginal area of their crop field.

Although there is more possible land for cultivation of these crops but all land has not been used for cultivation. These crops can resist the harsh environment, pest and can easily grow with less external effort on marginal land but still their production is not expected. Various factors are responsible for this, as low interest of people in these crops, lack of labor intensity and advanced technology, lack of knowledge on importance of these crops, easily availability of other main crops like rice, wheat in the local market. Beside these reasons, there is no feasible market to sell these crops so that the production of these crops is not gaining much value and respondents seen interested towards other commercial crops. Thus, people are less interested on the cultivation of these crops. Mostly these crops are grown in rain feed land (Bari), and in the study area most of the cultivable land was Bari and Khoriyan than Khet. So there is high possibility for the cultivation of these crops. Khoriya is the land where people just leave the land fellow or only for grass if this land is made cultivable for crops as Bari, the production potentiality of these marginal crops would be higher.

Hence, these underutilized crops has crucial role in the food security and livelihood of marginal people. So, it is necessary to increase their potentiality by utilizing marginal land, raising awareness program, using advanced agricultural technology, developing more research programs and increasing their value chain. Thus, by improving their potentiality, household food self-sufficiency and livelihood of marginal people can be maintained.

6. Conclusion and Recommendation

6.1 Conclusion

From the study I found that the agriculture was the main occupation and Brahmin and Chhetri were dominant caste. Majority of household were medium family size with less landholding. Most of the land was marginal and rain fed. The food self-sufficiency status was very low. Majority of the respondents were found self sufficient below six months from direct interview and from the calculation on the basis of calorie demand it was only 5.65 months. Most of the households having higher land, livestock, irrigation facility and small family size were able to produce sufficient food from their own farm. Also the respondents engaged in business and other jobs were able to fulfill their food demand.

Low landholding, low production and less interest towards local food crops were the main reasons for food insufficiency in own farm. Majority of the land was marginal with less irrigation facility and other agricultural inputs and technology, so the production was low. Similarly, with the changing life style, food preference and easily availability of imported food, local crops were found neglected. And respondents were found more interested towards commercial crops as vegetables, fruits, spices and so on. Thus, household food sufficiency was low. So majority of the people have to engage in off farm activities or sell local products to purchase preferred food (polished rice and wheat flour). The produced local crops were used for animals and other purposes rather than food.

Underutilized crops are found in several agricultural ecosystems and often survive mainly in marginal areas (Williams and Haq, 2002). Thus, they can play crucial role for the food security and livelihood of marginal people. As food security and poverty is general problem in rural hills and mountain.

Although the production of underutilized crops is less than the major crops they are also equally important to meet the basic needs for poor people. Beside their nutritional value and multiple uses they can be easily grown in harsh environment without chemical fertilizer and pesticides which is more beneficial. If underutilized crops are

given more priority, the problem of food insufficiency can be minimized. The production and use of marginal crop is decreasing. The main reason behind this is change in food preference and giving low priority to these crops. Thus, awareness program is necessary to change the concept of local people. The areas of mid hill like Hastichaur VDC have large marginal land which is applicable for these underutilized crops; due to lack of knowledge and promotion their production is low. By applying advanced technology and more agricultural inputs thus the production of these crops can be made higher which could be beneficial for the food security point of view and livelihood. Hence it is necessary to increase production potentiality of these crops.

Hence, the marginal land of mid hill and mountains are suitable for these local crops rather than other staple crops but due to low landholding and less interest towards these crops the total food production is low. This low production of food has increased the problem of household food self-insufficiency and thus to import large amount of preferred food (rice and wheat) from their income affecting their livelihood. Thus, if these local crops were promoted and increase their value and production, the condition of food insufficiency could be minimized.

6.2 Recommendations

Based on this study following recommendations are made:

1. Though these underutilized crops have multiple uses and high nutritional value but people neglect them and treat as low graded food, so awareness program is needed to raise the status of these crops.
2. Mid hill of Nepal has good potential of producing underutilized crops as there is large marginal land where other crops can't grow. So, it is necessary to focus on such programs which will promote the production of these crops among small farmers and help to improve food self-sufficiency.
3. The use and production rate of these crops is decreasing. So improvement in agricultural technology, their market channelizing and promotion is necessary.

References

- ABTRACO. (2006). Underutilized species policies and strategies: Analysis of existing national policies and legislation that enable or inhibit the wider use of underutilized plant species for food and agriculture Nepal. Agri-Business & trade promotion multi-purpose cooperative Ltd. (ABTRACO) Nepal 2006.
- Acharya, R. (2012). Ethnobotanical Study of Medicinal Plants of Resunga Hill Used by Magar Community of Badagaun VDC, Gulmi District, Nepal. *Scientific World*, **10**:54-65
- ADB. (2011). Global Food Price Inflation and Developing Asia. Mandaluyong City, Philippines: Asian Development Bank.
- Adhikari, J. and Bohle, H.G. (1999). Food Crisis in Nepal. Adroit Publication: Delhi.
- Adhikari, K.R. (2012). Economics of finger millet (*Eleusine coracana* G.) production and marketing in peri urban area of Pokhara valley of Nepal. *Journal of Development and Agricultural Economics* **4(6)**, 151-157.
- Anonymous. (2012). Food and Nutrition Security in Nepal: National Status from the Perspectives of Civil Society.
- Baniya, B.K. (1990). Buckwheat in Nepal. *Fagopyrum*, **10**: 86-94.
- Baniya, B.K., Dongol, D.M.S. and Riley, K.W. (1997). Characterization of Nepalese barley germplasm. *Barley and Wheat Newsletter*, **16**.
- Bhandari, K.H. (2012). Study on Climate Change Implications to Agricultural Practice and Food Self-Sufficiency in Rupakot VDC of Kaski District, Nepal. M.Sc. Dissertation. Environmental Science of Tribhuvan University.
- Biel, W. and Jacyno, E. (2013). Chemical composition and nutritive value of spring hulled barley varieties. *Bulg. J. Agric. Sci.*, **19**: 721-727

- Brush, S.B. (2008). *Farmer's Bounty: Locating Crop Diversity in the Contemporary World*. Yale University Press.
- CBS. (2001). VDC Profile, Central Bureau of Statistics, National Planning Commission Secretariat, Government of Nepal.
- CBS. (2003). Population Monograph of Nepal, **II** Kathmandu, Nepal, Central Bureau of Statistics.
- CBS. (2011). Nepal Living Standard Survey. Statistical Report, **II**. Central Bureau of Statistics, National Planning Commission Secretariat, Government of Nepal.
- Christa, K. and Soral-Šmietana, M. (2008). Buckwheat grains and buckwheat products – nutritional and prophylactic value of their components – a review. *Czech J. Food Sci.*, **26**: 153–162.
- Dawson, I.K., Hedley, P.E., Guarino, L. and Jaenicke, H. (2009). Does biotechnology have a role in the promotion of underutilized crops? *Food Policy* **34**, 319-328.
- DDC. (2007). Periodic District Development Plan. District Development Committee, Gulmi.
- Dipak, H.O.R.E. and R.A.T.H.I, R.S. (2002). Collection, cultivation and characterization of buckwheat in Northern Region of India. *Fagopyrum* **19**: 11-15.
- Ebert, W.A. (2014). Potential of Underutilized Traditional Vegetables and Legumes Crops to Contribute to Food and Nutritional Security, Income and More Sustainable Production Systems. *Sustainability* **6**, 319-335.
- Economist Intelligence Unit (EIU) report. (2014). Food security in focus: Asia and Pacific, 2014.
- FAO. (2004). The State of Food Insecurity in the World. United Nations Rome.
- FAO. (2005). The State of Food Insecurity in the World. United Nations Rome.

- FAO. (2008). *The State of Food and Agriculture*. United Nations Rome.
- FAO. (2009). *The State of Food and Agriculture*. United Nations Rome.
- FAO. (2010). *Assessment of Food Security and Nutrition Situation in Nepal*. UN Complex, Pulchowk, Nepal.
- FAO. and SAARC. (2008). *Regional Strategies and Programme for Food Security in the SAARC Members States*. FAO August 2008.
- FAO. and UNDP. (2003). *Nepal's Agricultural Policy and Strategies for Poverty Alleviation and Food Security*.
- Gamba, P. (2005). *Urban Domestic Pattern for Meat: Trend and Policy Implementations By*.
- Garí, J.A. (2004). *Plant diversity, sustainable rural livelihoods and the HIV/AIDS crisis*. UNDP.
- Gautam, M. (1993). *Food security, nutrition and hygiene in Nepal. A Report Prepared for the World Bank, Kathmandu*.
- Ghimire, S.R. (2007). *Rising Food Price and its Consequences*. MoAC. *Agriculture and Environment* **9**: 93-97
- Gill, G.J., Farrington, J., Anderson, E., Luttrell, C., Conway, T., Saxena, N.C. and Slater, R. (2003). *Food Security and the Millennium Goal on Hunger in Asia*. Overseas Development Institute (ODI).
- GoN. (2007). *Nepal Demographic and Health Survey 2006*. Population Division Ministry of Health and Population, Government of Nepal Kathmandu.

- GoN/MoAD. (2011/12). Statistical Information on Nepalese Agriculture, 2011/12. Agribusiness Promotion and Statistics Division Agristatistics Section, Singha Durbar Kathmandu Nepal.
- Graham, M.W. (2010). Grain amaranth production and effects of soil amendments in Uganda.
- IFPRI. (2010). The Global Hunger Index (GHI), 2010. International Food Policy and Research Institute.
- IFPRI. (2011). The Global Food Policy Report 2011. International Food Policy and Research Institute.
- Jaenicke, H. and Höschle-Zeledon, I. (2006). Strategic Framework for Underutilised Plant Species Research and Development with Special Reference to Asia and the Pacific, and to Sub-Saharan Africa. Biodiversity International.
- Janick, J. (1999). New crops and the search for new food resources. Perspectives on new crops and new uses. ASHS Press. Alexandria, VAUSA, 104-110.
- Joshi, N.P. and Maharjan, K.L. (2007). Assessment of Food Self-Sufficiency and Food Security Situation in Nepal. *Journal of International Development and Cooperation*, **13**: 209-230.
- Joshi, V., Gautam, P.L., Mal, B., Sharma, G.D. and Kochhar, S. (2001). Conservation and Use of Underutilized Crops: an Indian Perspective. *Managing Plant Genetic Diversity*, 359-370.
- Kathmandu Post,(Jan 20. 2012).
- Limu, P. and Thapa, K. (2011). Chepang Food Culture. Contribution of Wild Edible and Neglected Plant Species. Local Initiatives for Biodiversity, Research and Development (LI-BIRD), Pokhara, Nepal.
- Linehan, V., Thorpe, S., Andrews, N., Kim, Y. and Beaini, F. (2012). Food Demand to 2050: Opportunities for Australian agriculture. In ABARES. Paper presented at the 42nd ABARES Outlook conference: 6-7.

- Lines, T. (2012). Primary Commodity prices and Global Food Security, why farmers still struggle when food prices rise. Greenhouse, United Kingdom.
- Maharjan, K.L. (2003). Peasantry in Nepal: A Study on Subsistence Farmers and Their activities Pertaining to Food Security. Research Center for Regional geography Hiroshima University.
- Mal, B., Padulosi, S. and Ravi, S.B. (2010). Minor Millets in South Asia: Learnings from IFAD-NUS Project in India and Nepal. Bioversity International, Maccarese, Rome, Italy and the M.S. Swaminathan Research Foundation, Chennai, India.
- Maxted, N. (2009). Use it or lose it: improving the conservation/use link as a tool to sustain agrobiodiversity. *Acta Horticulturae*, **806**: 549–562.
- Mlakar, S.G., Turinek, M., Jakop, M., Bavec, M. and Bavec, F. (2010). Grain Amaranthus as an Alternative and Perspective Crop in Temperate Climate. *Revija za Geografijo-Journal for Geography*, **5**:135-145.
- MoAC. (2005). Statistical Information of Nepalese Agriculture: Time Series Information, Kathmandu, Nepal, Ministry of agriculture and Cooperatives, agribusiness promotion and Statistics Division.
- MOAC. (2007). Statistical Information on Nepalese Agriculture 2006/7. Kathmandu. Ministry of Agriculture and Cooperative, Nepal.
- MoAC. (2012). Agricultural Atlas of Nepal. Ministry of Agriculture and Cooperative, Nepal.
- MoAC., WFP. and FAO. (2009). Crop and Food Security Assessment: 2008/09 Winter Drought in Nepal, Joint Assessment Report – May 2009. Kathmandu.
- MoF. (2012). Economic Survey, Ministry of Finance, Government of Nepal.
- Mukherjee, A. (2008). Food Insecurity: a Growing Threat in Asia. United Nations Asia Pacific Centre for Agriculture Engineering and Machinery (UNAPCAEM), Beijing.

- OCHA. (2008). Nepal Needs Analysis Framework Key Findings September 2007. United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA). Kathmandu.
- Osmani, S.R. (1998). Food Security and Women: Lessons from Rural Asia, Part 1, Rome, IFAD/TAD.
- Padulosi, S., Mal, B., Ravi, S.B., Gowda, J., Gowda, K.T.K., Shanthakumar, G., Yenagi, N. and Dutta, M. (2009). Food Security and Climate Change: Role of Plant Genetic Resources of Minor Millets. *Indian Journal of Plant Genetic Resources* **22**(1): 1-16.
- Padulosi, S., Thompson, J. and Rudebjer, P. (2013). Fighting Poverty. Hunger and Malnutrition with Neglected and Underutilized Species (NUS): Needs, Challenges and the Way Forward. Bioversity International.
- Paudel, P., Devkota, B. and Kubota, T. (2009). Land degradation in Nepal: A Review on its Status and Consequences. *Journal of the Faculty of Agriculture, Kyushu University* **54**(2):477-479.
- Prasad, S.K., Pullabhotla, H. and Kumar, A.G. (2011). Supply and Demand for Cereals in Nepal, 2010-2030. Report prepared for the Cereals System Initiative for South Asia (CSISA), Discussion Paper, 1120.
- Pyakuryal, B., Roy, D. and Thapa, Y.B. (2010). Trade liberalization and food security in Nepal. *Food Policy*, **35**(1): 20–31.
- Regmi, H.R. (2008). Rising food price and its consequences. *The Journal Of Agriculture and Environment*,**9**:93-97
- Republica, (22 Feb 2011).
- Sapkota, C. (2011). Food Security and Aid in Nepal. Alliance for Aid Monitor Nepal (AAMN) Research and Policy Brief: 05.

- Shively, G., Gars, J. and Sununtnasuk, C. (2011). A Review of Food and Human Nutrition Issues in Nepal. West Lafayette (IN): Purdue University Department of Agricultural Economics Staff Paper Series, (11-05).
- Shrestha, N., Manandhar, H.K., Joshi, B.R., Prasad, D., Sherchan, K.P.P., Pradhan, A. and Bahadur, T. (2008). Poverty alleviation through agriculture and rural development in Nepal. Proceedings of the Regional Meeting Towards a Joint Regional Agenda for the Alleviation of Poverty through Agriculture and Secondary Crop Development: 97-118.
- This, E. (2000). Promising and Underutilized Species, Crops and Breeds. *GTZ Eschborn*.
- Tiwari, M. (2005). Marginal farmers, agricultural practices, and rural poverty in Nepal. *Jahrbuch der Österreichischen Gesellschaft für Agrarökonomie*, **12**: 123-147.
- TKP. (2011). Nepal to have food surplus this fiscal. *The Kathmandu Post*.
- Trostle, R. (2008). Global Agricultural Supply and Demand: Factors Contributing to the Recent Increase in Food Commodity Prices. Economic Research Service/USDA
- Vijayalakshmi, D., Geetha, K., Gowda, J., Ravi, SB., Padulosi, S. and Mal, B. (2010). Empowerment of women farmers through value addition on minor millets genetic resources: a case study in Karnataka. *Indian Journal of Plant Genetic Resources* **23**(1): 132-135.
- WFP. (2009). A sub-regional hunger index for Nepal. Nepal Food Security Monitoring System, World Food Programme, Nepal.
- Williams, T.J. and Haq, N. (2000): Global Research on Underutilized Crops- an assessment of current activities and proposals for enhanced cooperation. Biodiversity International.

World Bank. (2010). World Development Indicators. World Data Bank. Accessed November 10, 2010.