Chapter One
INTRODUCTION

1.1 Background

Nepal is a small landlocked country wedged between two large Asian countries, namely, China from north and India from east, west and south. It has total land area of 147181 sq. km with a population of 24.73 million. It is situated between $26^0 22^{'}$ to $30^0 27^{'}$ north latitude and $80^0 4^{'}$ to $88^0 12^{'}$ east longitude (CBS, 2004), along the southern slope of Himalayas to the plains. Its rectangular shape covers a length of 885 km east to west and an average width of 193 km north to south. Varieties of climate ranging from the subtropical to alpine are present in Nepal. The topography varies from the plain of *terai* with an elevation of 300 m asl to over 8000 m. in the altitude with Sagarmatha, (Mt. Everest, 8848 m.) as the highest point. Nepal is ethnically diverse Secular kingdom. It is home to several races, languages and religions. Politically the country is divided in to five development regions, 14 zones and 75 districts. Village development committees (VDCs) and municipalities are the lower administrative units in district. Ecologically Nepal has been divided in to *mountain, hill* and, *terai* belts. The *terai* belt consists of about 23 percent of the land where as the hill and mountains consist of 42 and 35 percent of the area, respectively. The *terai* belt shares a large chunk (57 percent) of the cultivable land (CBS, 2000). Nepal falls in the list of least developed countries according to its development indicators. Its per capita income is US $ 260 (MOF, 2004). Higher rate of population growth has been conceived as one of the key factors to this poor performance. As a result, the poverty is pervasive.

Kathmandu is the capital city of Nepal. Tokha is one of the traditional urban settlements in the north of Katmandu valley, in the lap of Shivapuri watershed. Presently, Tokha includes two VDCs namely- Tokha Saraswoti and Tokha Chandeswori. Tokha is surrounded by the Bishnumati Khola to the east; Sanglakhola to the west; Sapanatirthakhola to the north and the area is located within about 10 km out from Kathmandu (DADO, 2004). There are different legends regarding to the nomenclature of the "Tokha". A more acceptable legend (according to the local Newar tribal communities) is that Tokha was famous for Chaku, a raw product from sugarcane, so called as "Tokhya" (To = Sugarcane; Khya = growing field/ area, in Newari language). Later on,

the city was named as Tokha (Sapkota, 1999). Presently, Tokha lies in urban periphery with an immense agricultural potentiality.

1.2 Agriculture and Nepalese economy

Agriculture is the backbone of Nepalese economy. More than 65% of the Nepalese population engages in agricultural occupation. Agriculture in general is basically rural based occupation. About 85.8% of the population in the country lives in the rural area (CBS, 2003) and agriculture continues to be dominant sector in the Nepalese economy. Agriculture extends employment opportunity (full and partial) to 80 percent of the population (AEC, 1998). The development and enhancement of the productivity of this sector plays vital role in the productive employment generation and improving economic development of the country.

Performance of Nepalese Agriculture sector is not encouraging. During mid seventies Nepal was known to be the food exporting country. The share of agriculture gross domestic product (AGDP) is decreasing overtime. Considering the fact, the government has launched 20 years strategic plan, Agriculture Perspective Plan (APP) to bring about acceleration at growth in agriculture sector. APP seeks to raise agriculture GDP growth from 2.96 percent in 1992-1995 to 4.88 percent by 2011-2015 (APPRSC and JMA, 19995).

1.3 Urban Agriculture

The term 'urban' refers to the over-crowded, more developed and facilitated area and urban settlement is civilized one more advanced than rural. The agriculture is supporting urban life in many ways. Tangible benefits from agriculture include food, fiber, fodder, fuel wood, building materials and so on. Environmental and social benefits relate to public health, recreation, and well being of the urban population. Urban agriculture (UA) refers to the production and management of crops, poultry and/or livestock products in the urban or periphery area, specially to meet local needs, including urban greenery management. There are two broad options for urban employment-agricultural and non-agricultural. UA is an option for employment and income generation for the low skilled, low education, poor and marginalized people, especially the migrants

in urban areas. As the agriculture is the total way of life supporting system, UA should be achieved in such a way that it is supportive to alleviate poverty and food insecurity and to be market and technologically driven so as to enhance overall productivity of the marginalized urban farmers. This study analyzes the urban agriculture in Tokha, Kathmandu in a systematic approach for its contribution to the urban income and nutrient supply.

1.4 Statement of the problem

Urbanization in Kathmandu valley is rapid. The pressure of population growth and migration is very high in Kathmandu (DDC, 2005). This rapid growth of urban areas is exacerbating serious problems such as scarcity of food, fuel, water, employment, and shelter. Agriculture is still the fundamental basis for urban development in developing countries like Nepal. Urban development or urbanization seems to be different from agricultural development. But, for the fulfillment of human needs in the urban and peri-urban areas, agricultural activities or functions are increasingly practiced. Whether the promotion of agricultural farming especially in the urban areas is socio-economically and ecologically justified function for the food security, overall development and sustainability of the urban society? This is one of the genuine research questions and in fact, the impact of the urban agricultural farming activities has to be critically reviewed with theoretical, practical and scientific bases for the prosperity of mankind and integrated urban-rural development. This study attempts to bridge these information gaps regarding urban agriculture and poverty issues in Kathmandu, Nepal.

1.5 Rationale of the study

UA tends to complement rural and foreign sources of food supply to cities, strengthening poor urban households' food security in particular (Mougeot, 2000). Green areas can also provide habitats for biological diversity, protection of watersheds for urban water supply and productive uses or safe disposal of urban wastes. However, some negative consequences also come with urban agricultural practices.

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the low skilled, low education, poor and marginalized people, especially rural-urban migrants. As the agriculture is the total way of life supporting system, UA should be achieved in such a way that it is supportive to alleviate poverty and food insecurity and to be market and technologically driven so as to enhance overall productivity of the marginalized urban farmers.

Urbanization is an invisible force, transforming patterns and styles of living not only in towns but also within the surrounding rural hinterland areas. Agriculture is the main economic basis of development, but agricultural growth and development requires strengthening urban-rural linkage (Pradhan, 2003). UA is one source of supply in urban food systems and only one of several food security options for households. It is also one of the tools for making productive use of urban open spaces, treating and recovering urban solid and liquid wastes, generating income and employment and managing resources more effectively (Mougeot, 2000), along with conservation and management of urban environment. This study will investigate and analyze on both the positive and negative aspects of urban agricultural functions for the development of market towns and rural hinterlands.

1.6 Objectives of the study

The general objective of this study is to examine the contribution of agriculture in poverty alleviation in urban periphery of Kathmandu valley. More specifically this study aims to:

(i) Analyze the attitudes of the urban people towards agricultural occupation.

(ii) Identify the contribution of agriculture sector in urban economy.

(iii) Analyze the impact of urban agriculture on environment, health and nutrient supply to urban farmers.

(iv) Examine the role of organizations supporting to agriculture in the urban area.

1.7 Major assumptions

The study analyzed the role of urban agriculture to generate employment and income along with nutritional supply and socio-economic implications. This also attempts to analyze the attitudes of the urban people with regard to the organizations

involved in supporting to agriculture development activities in the study area. This study was based on the following basic assumptions.

- The attitudes of the urban people towards agriculture and non-agricultural occupation functions are different.
- There is an important contribution of farm products to urban economic development.
- Nutrition required to the poor urban farmers are supplied from agricultural crops.
- Agricultural production functions have both positive and negative impacts on the urban environment.
- Different governmental and non-governmental organizations are supporting to agriculture development activities in the urban periphery.

1.8 Scope and limitations of the study

The study will examine the role of urban agriculture to generate employment and income along with social, economic, nutritional supply and environmental impacts or implications. This will also analyze the attitudes of the urban people with regard to increasing agricultural production, with identification of the organizations involved in supporting to agriculture development activities in the study area. The output of the study will have an immense scope in regional planning and policy formulation for integrated rural-urban development. However, this will not cover the aspects of technology generation and improvement pertaining to urban agriculture farming.

Chapter Two

REVIEW OF LITERATURE

This chapter deals with the review on different aspects of urban agricultural systems, employment and poverty reduction issues or perspectives.

2.1 Theoretical issues and concepts

The term 'urban' refers to the over-crowded and facilitated area, more advanced than rural. Agriculture is supporting urban life in many ways. Tangible benefits from agriculture include food, fiber, fodder, fuel wood, and building materials and so on. Environmental and social benefits relate to public health, recreation, and well being of the urban population. UA tends to complement rural and foreign sources of food supply to cities, strengthening poor urban households' food security in particular (Mougeot, 2000). Green areas can also provide habitats for biological diversity, protection of watersheds for urban water supply and productive uses or safe disposal of urban wastes. However, some negative consequences also come with urban agricultural practices.

Urban Agriculture is defined as the production of crops and livestock within the administrative boundary of the city (Mbiba, 2000). Urban agriculture can be classified in three categories based on its location:

1. **On-plot agriculture**: Farming practised on the plots around the houses, like backyard gardening. It involves mainly crop production. Poor households, tenants, and recent rural-urban migrants hardly have access to on-plot land.
2. **Off-plot agriculture**: This is conducted in public open spaces, utility service areas and agricultural allotments. The production is mainly for home consumption and some percentage is marketed. The poor and vulnerable groups, who could participate in this sector, are progressively pushed out by higher income households.
3. **Peri-urban agriculture:** This category of urban agriculture is the production of crops and livestock in areas outside the city boundary- up to a radius of 150 km- which is economically integrated into the city. This sector offers

immediate and viable options for enhanced food production to meet the employment and nutritional needs of the city (Mbiba, 2000).

Some features of these three categories of urban agriculture have been presented in the Appendix 11.

Urbanization is an invisible force, transforming patterns and styles of living not only in towns but also within the surrounding rural hinterland areas. Agriculture is the main economic basis of development, but agricultural growth and development requires strengthening urban-rural linkage (Pradhan, 2003). UA is one source of supply in urban food systems and only one of several food security options for households. It is also one of the tools for making productive use of urban open spaces, treating and recovering urban solid and liquid wastes, generating income and employment and managing resources more effectively (Mougeot, 2000), along with conservation and management of urban environment.

Bhattarai (2003) has described the issues in agriculture development in terms of four law of motion in agriculture as- (i) the question of 'prime mover' in agricultural development (Lenin seems to use the term 'carrier of technical process' interchangeably for 'prime mover'); (ii) the operation of the law of socialization in agriculture; (iii) characterization of 'peasant proprietorship'; and (iv) differentiation of the peasantry. As described by him, ***Land*** (the basic material element of agricultural production) and ***labor*** (the principle source of value in all production) are the basic conditions of factors of agricultural production. Besides, ***irrigation*** and ***modern inputs*** are the other factors of agricultural production. The absolute measure of level and growth of agricultural production is of crucial significance for a society dominated by use-value production. For this, it would be pertinent to evaluate the situation first with respect to:

- Cropping pattern and cropping intensity
- Level and growth of production by major crops, and
- Net food balance.

Bhattarai (2003) has also described and generalized the agrarian spatial structure of Nepal with the distribution of levels of development along Terai, Inner Terai, Kathmandu Valley and area of absolute backwardness or retardation in the vast

hinterlands of hill and Mountain, which can be taken as a typical manifestation of the underdevelopment process operating in the Nepalese economy.

3.2 Efforts on agriculture development in Nepal

Nepal is small but extremely diverse country with more than 24.8 million people at present (CBS, 2004). Agriculture in Nepal is contributing 65% employment of the economically active population. The share of agriculture in GDP is about 38%; more than 80% of the rural population depends heavily on agriculture sector for their employment and about 65% of the total income of rural households comes from agriculture (Kaini, 2003). As more than 80% rural population depending on agriculture and they are mostly fall below poverty line, poverty alleviation without agricultural development is not possible in Nepal. Realizing this fact, the government of Nepal has set a principal development objective of poverty reduction through agricultural development for the Tenth Plan (2002-2007). Poverty reduction is one of the principal objectives of the 20 years Agriculture Perspective Plan (APP, 1995-2015). To achieve the objectives, APP has identified livestock, high value crops, agribusiness and forestry as its priority outputs. Commercialization of agriculture is essential for alleviating poverty in Nepal and it is realized that agriculture can only be commercialized by effective uses of information and communication technologies, giving the farmers a commercial orientation (Kaini, 2003).

Agriculture development in Nepal has passed through various models of development. In each model, horticulture and livestock sector have got the priority. With a view to put agriculture into a high growth path, APP was implemented. However, it failed to relate the development activities with the institutions responsible to implement them (Thapa, 2001).

The aggregate agrarian process in Nepal is characterized by low technical level of production, pre-capitalist (or semi-feudal) relations of production, disarticulation with other sectors of economy- particularly industry, and a general state of stagnation and retardation (Bhattarai, 2003).

Agriculture sector in Nepal has remained as the main basis of food security, rural employment, poverty level reduction and national income (Shrestha, 2004). As a landlocked underdeveloped country with basically an agro-based economy, Nepal has to

choose a road that fits own sustainable situation (Devkota and Ghimire, 2005). As a member of World Trade Organization (WTO), Nepal is to fulfill obligations and commitments required by WTO/SPS agreements latest by January 1, 2007 (Shrestha, 2005).

The Kathmandu Valley has an exotic setting and consists of three main towns of great historic and cultural interst- Kathmandu, Patan and Bhaktapur (NTB, 2003). Based on updated agricultural data and information (DDC, 2005; DADO, 2004), the agricultural scenario in the Kathmandu district has been presented in Appendix 13.

2.3 Poverty, agriculture and rural-urban development interrelations

Poverty is the major challenge to development and principal obstacle for prosperous human life (Devkota, 2006). Poverty and agriculture are interrelated to each other and the percentage of population below poverty line is estimated to be 23 and 44 in urban and rural areas, respectively. The APP has estimated that it would reduce poverty at a rapid rate to 14% within 20 years and the plan is designed to encourage those activities that skew the income distribution towards the poor, particularly, the poor women (Kaini, 2003). Some of the prominent agricultural programs that the government has focused to achieve the poverty reduction goal are vegetable and fruit production programs, fishery development program, sericulture and apiculture, goat farming, pig and poultry farming, agricultural training creating self-employment opportunities, and so on.

Agricultural and socio-economic development is such development that is people centered, concentrating on improving the human condition, and conservation based, maintaining the variety and productivity of the nature (Devkota, 2004). In this context, new options need to be researched to broaden the non-chemical approach of farming, directed towards ongoing problems of continuous agricultural production (Midmore, 1998, CABI Bioscience and FAO, 2000).

Agriculture and rural development are intrinsically interrelated elsewhere in the developing countries, especially true for a country like Nepal. It is claimed by the scholars that, for Nepal, agriculture is and will remain a major contributor to the sustenance, employment and development of the poor as well as the better-off sections of the population for a long time (Ojha, 2006). Even in Japan, which is now a well known as

an industrialized developed country, the number of people relying on agricultural sector did not reduce during a long period between 1870 and 1940. Such number did not decline even until the 1960s, although non-agric employment grew substantially by that time. In countries and areas such as Taiwan, Kenya, Thailand, Costa Rika, Columbia, and Punjab (India), it was the development of agricultural sector that chiefly led to economic growth and overall prosperity among the people.

2.4 Urbanization and agriculture

The world's urban population is expected to reach 5.5 billion by 2025, 80% of which will live in urban centers of developing countries. Many of those who migrate to cities, however, fail to obtain the desired occupations, being forced to exist at low level of subsistence in slums, mushrooming in the outskirts of the cities. Therefore, in developing countries, an increasing proportion of the target group for poverty alleviation is found to be in the urban centers. Thus, cities in developing countries which have been affected by recent economic crises, have seen an upsurge of urban agricultural activities and the debate over the value of urban agriculture as an acceptable input in sustainable urban development has recently gained momentum (Bakker *et al*, 2000).

An important factor for the development of market town is agriculture and the climate is the single most important factor of agricultural development, particularly in mountainous country, like Nepal. But the potential production cannot be achieved due to inadequacy of irrigation water (Pradhan, 2003).

2.5 Urban agriculture, food security, health and nutrient supply

The concept of food security has been on the international agenda and urbanization is an inevitable consequence of socio-economic development. Urbanization also influences all aspects of production and consumption. Specific aspects of food security applicable to the urban context include (i) the necessity to purchase most of the food needed by households; and (ii) greater dependence on the market system and commercially processed food. Waged employment and monetary income are therefore the main prerequisites for achieving food security (Armar-Klemesu, 2000). Since the early 1990s, as a result of political transition, two severe humanitarian and food crises

occurred in Sofia (Bulgeria): the first from 1990-91; and the second 1996-1997. During these crises, urban agriculture remained the most important way to overcome food shortage and was a strong stabilizing factor for food security of the population in Sofia (Yoveva *et al*., 2000).

Health issues in urban agriculture are mainly related to pollution- both chemical and biological- of food prior to harvesting and possible contamination during marketing and distribution. Armar-Klemesu (2000) has described the human and environmental health risks of inappropriate urban agricultural practices from the following ways:

- Inappropriate handling of agrochemicals by producers;
- Crop selection or location without due regard to the ambient pollution in the air, soil or water.
- Livestock production;
- Application of unsorted or insufficiently treated solid and liquid organic wastes to vulnerable crops; and
- Poor handling during processing, marketing and distribution.

The WHO Surveillance Program for Control of Food-borne Infections and Intoxications in Europe has reported a dramatic increase in food-borne diseases over the last 10 years (Armar-Klemesu, 2000). Indiscriminate use of agrochemicals, such as fertilizers and pesticides, may significantly increase agricultural yield, but the residues can also have negative impacts on the environment and human health. At the same time, livestock production in cities can also be potential source of health problems. Livestock are the important carriers of parasites, bacteria and viruses that are dangerous to human health. For example, cattle, sheep, goats and pigs and horses are important reservoirs for the *Cryptosporidium* parasites, excreting them in their faeces. Known routes of transmission are animal-to-person, consumption of animal produce and faecal contamination of environment, particularly by fertilization of crops with sewage sludge or waste water irrigation. Likewise, foods most often involved in disease outbreaks are raw or insufficiently cooked meat, milk, poultry and eggs (*Salmonella*).

One of the main beneficial impacts of urban agriculture is the potential to recycle urban waste products. Organic waste is popularly used as compost, which is certainly a

favorable practice. However, attention must be given to health risk from the handling and application of manure from vector-carrying animals and the use of composted domestic waste also poses health risks if trash has not been sorted properly. Different governments and International organizations, such as FAO, UNDP and WHO, are involved in training research and development on environment and health effects and advocacy. According to Armar-Klemesu (2000), some recommended least-risk farming strategies may include:

- **Crop choice**: for example, the metal absorption ratio in plants is (fruit+seeds): (leaves+roots) = 1:10, showing that fruits and seeds are ten times safer to grow and consume than leaves and roots in polluted area.
- **Use of cash crops or bio-remediation** (using plants that take up toxic waste): Growing hedging species which can take up pollutants in soil and act as barrier to air borne pollution.
- Location of production: Vegetables grown in industrial or mining, near road and close to emission sources suffer from contamination (such as higher deposition of lead particles).
- Other possibilities: Involve adoption of farming techniques that prevent contact with contaminated soil altogether by growing crops in containers or raised beds with growing media or using hydroponics.

The consumption of enormous quantity of organic materials, such as foodstuffs by cities generates a correspondingly high quality of organic waste estimate as amounting to 2/3 of all urban waste. The recycling of such urban organic waste in urban and peri-urban agricultural activities closes these nutrient cycles, reducing the cost of disposal and serves as an environment friendly solution to some of the negative ecological impacts of cities. At the same time, urban agriculture can serve as a means of maintaining open spaces-green space- in urban areas (Pfeifer *et al*., 2000).

Maxwell *et al.* (1998) report the linkage of urban agriculture and malnutrition in Kampala (Washington). When controlling for socio-economic status and other individual and household characteristic, they found that urban agriculture is positively and significantly associated with higher nutritional status in children, particularly in terms of higher-for-age, and there is a significantly lower proportion of moderately to severely malnourished children in households where someone is farming.

2.6 Urban agriculture and employment generation

In the present decades, poverty alleviation has been sought at its roots in rural areas by making rural life attractive enough to reduce the rural-urban migration of youths in particular. However, cities in developing countries, which have been affected by recent economic crises, have seen an upsurge of urban agricultural activities. Therefore an increasing proportion of the target group for poverty alleviation is now found in urban and peri-urban areas. And, many of the poor find employment in commercial urban agriculture undertaken in open spaces, supplementing their family diet with the help of a range of urban agricultural activities such as market gardening or livestock and poultry rearing. Once established in the city, some even secure access to the resources required to facilitate self-employment in urban agriculture (Pfeifer *et al*., 2000).

2.7 Urban agriculture and environment

Urbanization in Kathmandu valley, including urban agricultural practices, implies various environmental implications. Both the forest and agricultural areas have decreased in the valley. The encroachment and decline in the forest area has affected not only the water recharge capacity of ground water sources, but also caused frequent landslides and soil erosion on the surrounding hill slopes and flash floods in the valley floor. Studies shows that the accelerated and haphazard urban growth and agricultural practices in the Kathmandu valley has resulted into squatting of open-public places, mismanagement of solid wastes and sewers, increasing in slums, increasing level of pollution of water and air, depleting water sources, and so on are pronounced as environmental consequences (Pradhan, 2004). There is a fast growing interest in organic gardening and food seems to catalyze environmental concern, indicated by the rise in organic food sales. At the same time, urban agriculture in London has significant environmental effects (Garnet, 2000), as:

- Pesticides- more likely to be used by food growers have been reduced and many growers walk to grow organically.

- Composting practice increased which cause a major environmental benefit of food growing schemes.
- Sewage is another untapped source of compost. Thames Water produces and sells more than 30% of the anaerobically-treated sewage used compost used in UK agriculture and marketed through garden centers.
- Urban food production can play a significant role in reducing food transportation.
- Organically managed allotments can also promote urban biological diversity, as can unused sites which harbor wildlife.
- Food growers also reduce their non-food waste by substituting own grown vegetables for packaged foods.

The status of urban agriculture can be guided by the public and official view that urban agriculture poses a threat to the environment. Researchers have attempted to establish the extent of the threat and potential benefits such as CO_2 reduction, composting and microclimate improvement (Mbiba, 2000). The key research findings are summarized in Appendix 12.

2.8 Urban agriculture and sustainability

The international community is addressing the increasing issue of urban sustainability. The process began in Rio Earth Summit (1992) with Agenda 21, which called for all countries to develop National Strategy for Sustainable Development (NSSD) to translate the words and commitments of the Earth Summit into concrete policies and actions (Lekhak and Lekhak, 2003). It is recognized that cities nowadays use too many natural resources and produce too much waste. The ecological footprints of cities are stamping out the habitat of many species. Moreover, cities are confronted with an increasing number of people and, therefore, an increasing number of mouths to feed. Along with other initiatives and activities, urban agriculture therefore has an important role in contributing to the future sustainability of cities (Deelstra and Giradet, 2000).

2.9 Institutional aspect of urban agriculture

Mwalukasa (2000) analyses the mechanism of institutional strategies of urban agriculture in the context of an East African city, Dar es Salaam, which is one of the fastest growing cities in sub-Sahara Africa. The analysis shows that the policy agenda needs to focus on managing urban land uses for improving production of food to sustain the growth of cities. `In the past, the growth and development of Dar es Salaam has been guided by the 1979 Master Plan that provided the framework to manage the future growth and development of the city. New initiatives includes that the sustainable city program builds capacity of municipal authorities to enable them to plan, co-ordinate and manage their urban development through application of environmental panning and management (EPM) approach. The process is being carried out by the sustainable Dares Salaam Project (SDP) which focuses on the environment-development interaction and is both bottom-up and stakeholder-driven (Mwalukasa, 2000).

A working group within SDP was formed to deal with the development and management of urban agriculture in relation to recreational areas, open spaces, hazardous areas and greenbelts. The group comprised representatives from various stakeholder groups:

- Segments of the urban dwellers (urban poor, youth, women, etc)
- Village governments (especially in the peri-urban areas)
- Various government ministries and fiinancial institutions
- The Dar es Salaam City Council
- National Environment Council
- Business groups and informal businesses
- Civil Society groups, NGOs, and CBOs within the cities and in the urban villages
- Informal business, such as petty trading, street hawking, street food vending, marketing operators
- Livestock owners/ Keepers, etc.

The other instruments to enhance the urban agriculture strategy included informal campaigns, economic incentives, provision of finance for long-term investments, regulations and increasing co-ordination. The institutional aspect indicates that future emphasis needs to be placed by the city authorities if urban agriculture is to prosper. This

consensus is being practically addressed through cross-sectional working groups (Mwalukasa, 2000).

2.10 Urban agriculture on policy agenda

Urban agriculture exists under the range of policy environments that may be prohibitive or supportive to its existence and development (Zeeuw *et. al*, 2000). It can have different purposes, such as, food security /subsistence; city ecology improvement; and income or employment generation. Urban agriculture has been variously studied and included in the policy agenda for sustainable urban development in different parts of the world (Gertel and Samir, 2000; Mbaye and Mousetier, 2000; Jacobi et. al, 2000, Mbiba, 2000; Foeken and Mwangi, 2000; Novo and Murphy, 2000; Lima et. al, 2000, Kreinecker, 2000; Nunan, 2000; Purnomohadi, 2000; Yi-Zhang and Zhangen, 2000; Garnett, 2000; Yoveva *et. al*, 2000).

City farming is one of the strong and positive urban residents are undertaking in an effort to take control of food security, social ills, and environmental degradation in their communities (Bourque, 2000). It has provided food, jobs, environmental enhancement, education, beatification, inspiration and hope (UNDP, 1996). Mwalukasa (2000) highlights the structural and policy problems of urban agriculture in the context of the African city Dar es Salaam with key aspects of new strategy to prosper urban agriculture. The strategy has the following elements.

- Restructuring land access and land-use laws.
- Using new urban agriculture techniques to use land more intensively (in small and marginal areas)
- Incorporating non-food production, for example, floriculture and arboriculture (planting trees on roadsides, in homes, watersheds).
- Moving large livestock to peri-urban areas.
- Composting of organic waste collected in the city centers and transporting to it to peri-urban areas.
- Generating biogas where composting is taking place.
- Encouraging people to use more underground water from wells an boreholes, using hand pumps and electricity, where possible.

- Using biodegradable wastes from market centers and homes for composting to grow mushrooms, and
- Developing aquaculture in coastal lagoons and other appropriate inland areas and in tanks.

A mixed land use strategy for the city that would incorporate the demand for agricultural activities has several specific components (Mwalukasa, 2000), such as:

- Maintaining green spaces with flowers and ornamental trees to beautify the city.
- Avoiding sub-division of the areas by overbuilding, and keeping open spaces under some form of agriculture.
- Maintaining tree wind breaks to reduce air pollution.
- Encouraging livestock keeping and crop growing in low density residential areas where this is already common practice, provided stipulated bylaws are followed.
- Supporting vegetable growing and small livestock keeping in high-density areas where open space is available and small scale farming is common practice.
- Large peri-urban areas should be allowed space for fodder production, disposal of manure or construction of composting systems.
- No livestock rearing in high density residential areas.
- Zero-grazing in built-up low density residential areas, and
- Open grazing only in peri-urban areas.

Adopting the above mentioned strategies, the project for urban horticultural garden development in the Dar es Salaam to provide urban food security, create jobs and alleviate poverty.

Cities in developing countries, which have been affected by recent economic crises, have seen as upsurge of urban agricultural activities. The debate over the value of urban agriculture as an acceptable input in sustainable urban development has recently gained momentum (Pfeifer *et al.*, 2000). As a consequence it has drawn the attention of a growing number of policy makers and commentators in and around municipalities, bi-lateral and multilateral organizations, NGOs and universities to the subject of urban agriculture.

Nepal's resource base for agriculture is severely limited by the nature of the terrain. Only 3.1 million hectares or 21% of the total land area is cultivated and there is no significant potential for expansion. Due to high population pressure, the average landholding is declining over the years. Poverty, food insecurity, social and economic inclusions are the major problems, especially in the rural areas of Nepal (Joshi, 2006). The mountain agriculture is traditionally composed of elements of self-sufficiency. Nepalese hill farming includes the field crops, livestock; horticulture, forest and beekeeping cover the risk against famine and other natural disaster (Pokhrel, 2005). There is extreme skewedness in the spatial distribution of cultivated land in the country (Bhattarai, 2003).

The Kathmandu valley has an exotic setting surrounded by a tier of Green Mountain. Even in the highly urbanized Kathmandu valley, large tracts of land outside the city area are devoted to farming (NTB, 2003). And, agriculture in the Kathmandu city cannot be ignored while thinking and executing for overall development of the city. Thus, the integration and/or inclusion of urban agricultural development in Kathmandu city is essential for integrated urban-rural development, poverty alleviation and urban food security (Pradhan, 2003). Bhandari (1995) carried out a study on social determinants of agricultural productivity in hill farming systems with a case study spring maize productivity at Khamari Village, Gorkha, Nepal and the major suggestion/ recommendations to increase crop productivity includes the need of establishment of farmers level cooperative for agricultural inputs supply, effective extension service, soil conservation and fertility restoration.

Chapter Three

RESEARCH METHODOLOGY

This chapter consists of the description of the study area, conceptual framework of the study, sampling and surveying procedure, source of data/information and collection techniques and techniques of data analysis.

3.1 The study area

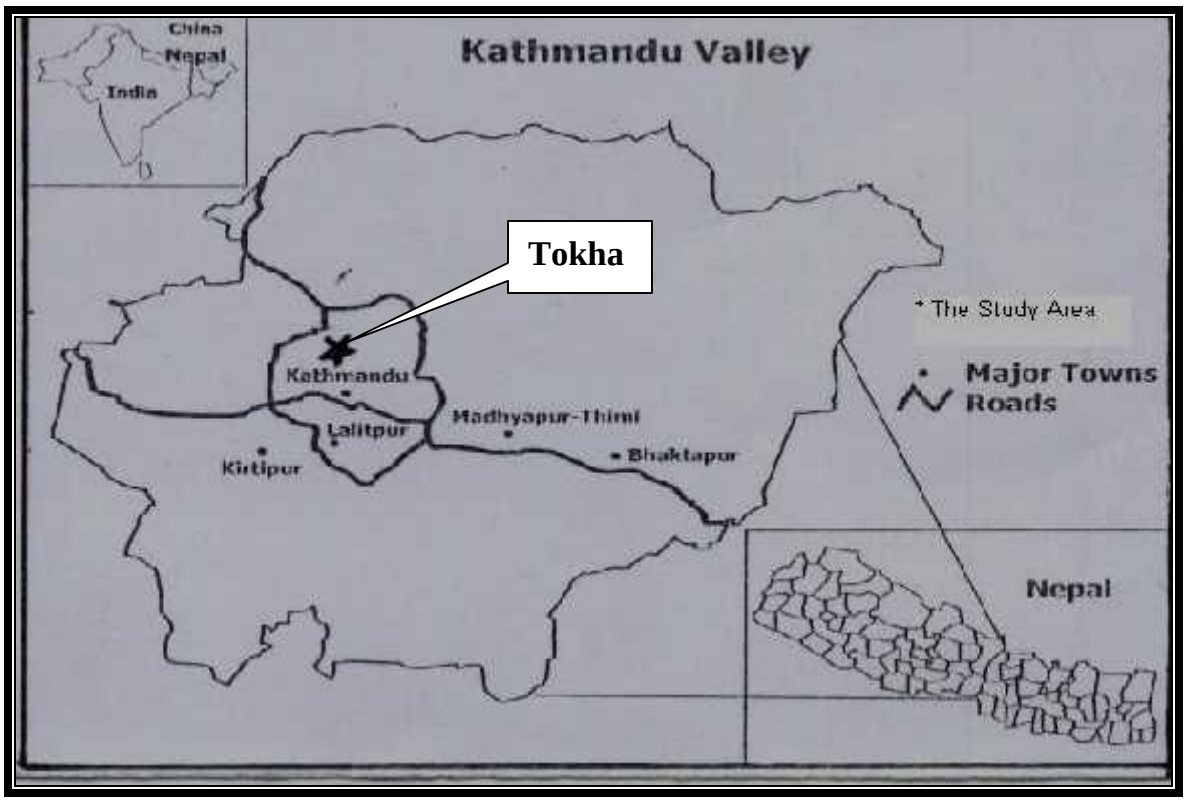
The site of this study was Tokha area of Katkmandu district, which includes Tokha Saraswati and Tokha Chandeswari village development committees. The area lies to the west of Bishnumati Khola (which originates properly from Tokha), within about 10 km out from the Kathmandu Metropolitan City (DADO, 2004). This area is a typical urban periphery with an immense agricultural potentiality. The main source of primary data is sample survey applying snowball sampling technique in three urban pockets (figure 1 and 2). The selected three urban agriculture pockets are:

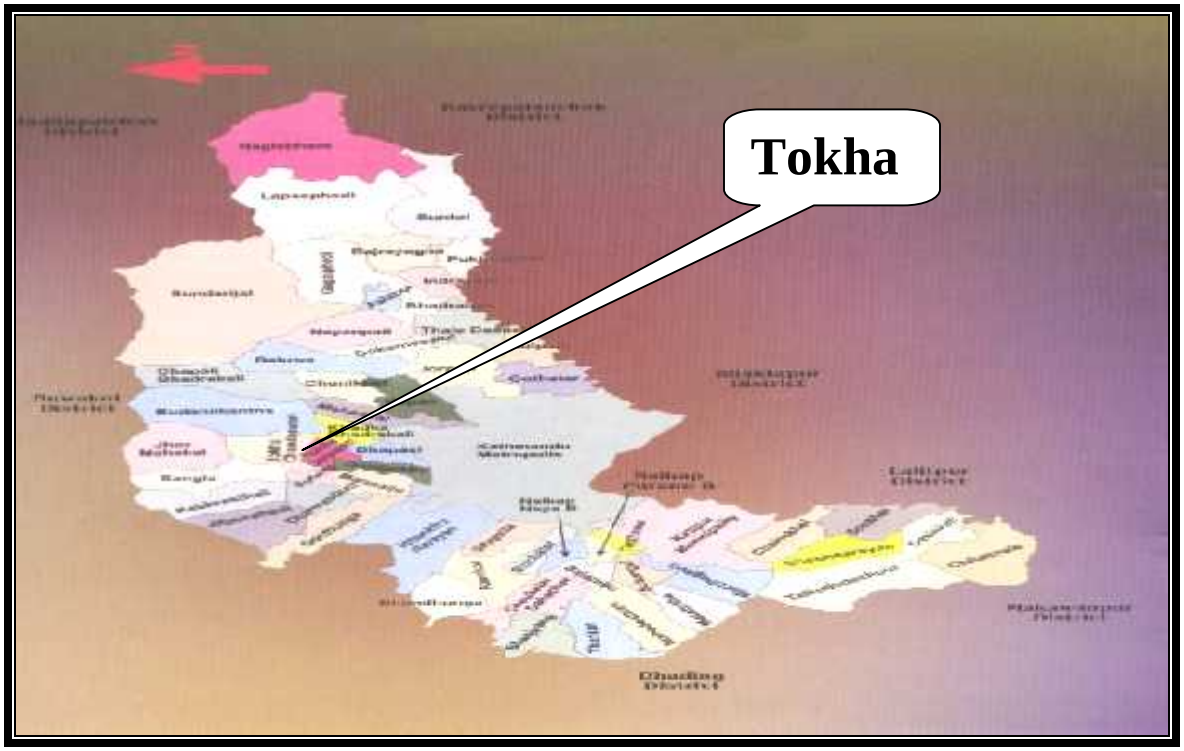
1. First one road accessible pocket (P_1) - Tokha Saraswti, Ward No. 2 and 6.
2. Second one less accessible pocket with human settlement (P_2)-Chandeswori-2.
3. Last one isolated pocket (P_3) – Sapnatirtha, Tokha Chandeshwori- 1.

3.3 Collection of primary data and information

This study was carried out in February-June, 2006. In order to collect primary data and information, sample survey, observation and key informant interviews were conducted in the study area in February and March, followed by processing, tabulation and analysis of the collected data and information along with the gathering and citation of secondary information sources. Primary data and information were collected in February-April, 2006 through sample survey applying snowball sampling technique, considering the households with more than 0.2 ha of farmland as sampling units in the three urban pockets. Farmers' interview, observation and key informant interviews were conducted, which includes total 64/64 household surveys and observations, along with key informant interviews and group discussions (Table 1).

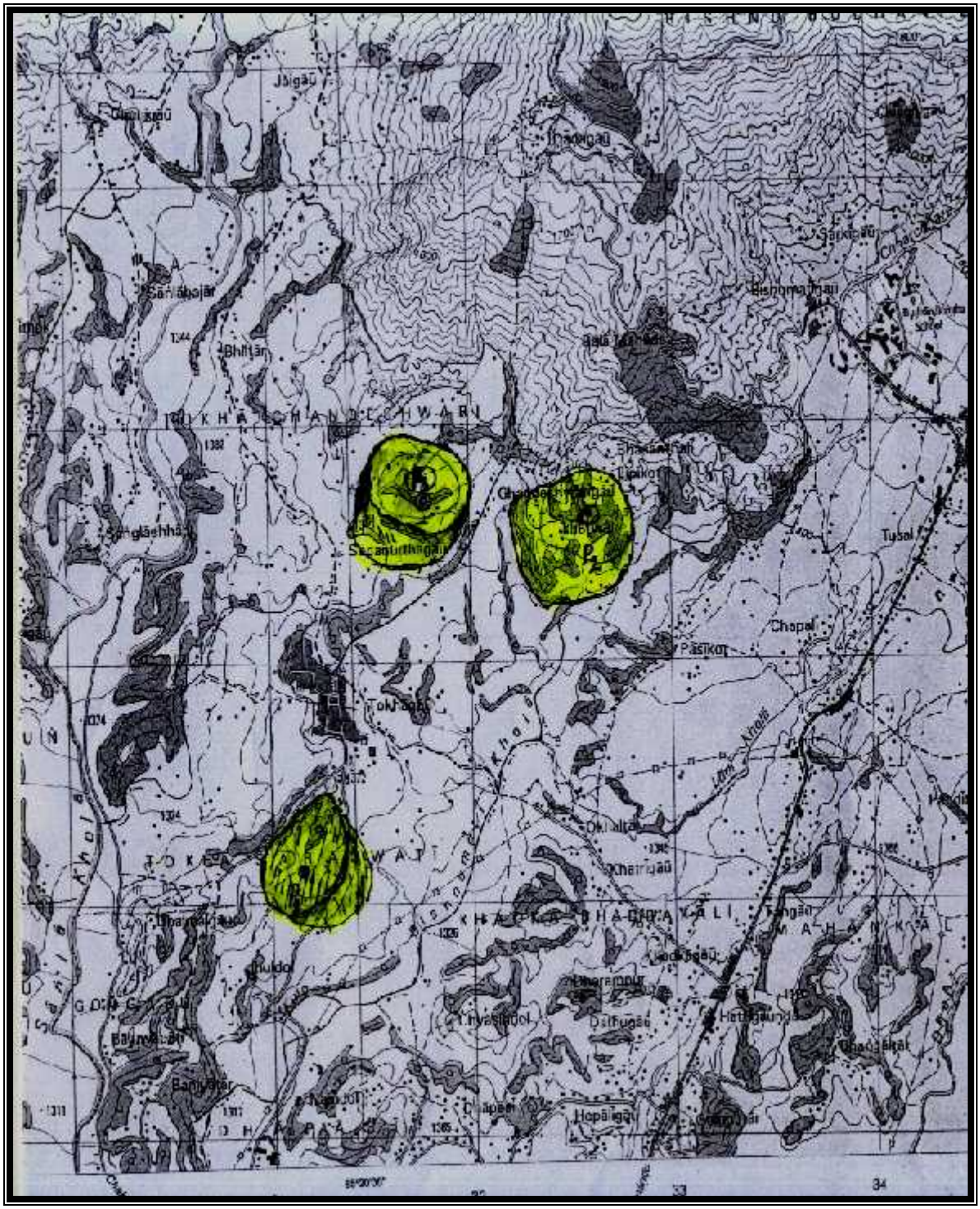
Figure 1. Map of Nepal showing the Kathmandu Valley and Tokha, the study area.





(Map of Kathmandu District)

Figure 2. Map (Topo sheet) showing Tokha area, location of the study areas



Selected Pockets:

P_1 = Accessible pocket (Saraswoti, Tokha Saraswoti, ward no. 2 and 6)
P_2 = Less accessible pocket (Chandeshwori, Tokha Chandeshwori, ward no. 2)
P_3 = Isolated pocket (Sapanatirtha, Tokha Chandeshwori, ward no. 1)

Figure 3. Sample urban agriculture locations.

Sapnatirtha (P_3)

Chandeshwori (P_2)

Saraswoti (P_1)

3.4 Techniques of data collection and analysis

3.4.1 Sources of data and information

The study is based on both primary and secondary source of data and information. The main sources of primary data include snowballing sample survey, key informant interviews and visual observations. The main sources of secondary data/information include reports, documents, maps, journals, books, etc published by various institutions and organizations.

3.4.2 Selection of the pockets

Suitable pockets for snowball sampling survey provisionally selected by using topo-sheet (1:25000), followed by visual observation and final selection.

3.4.3 Sampling and surveying procedure

Snowballing sample survey, which includes firstly interview with a respondent characterized by the qualities needed then asking him/her for names of people having the same qualities whom he/she knows, was carried out in the selected pockets, followed by observation and key informant interviews. Direct interviews with farmers was carried out by using structured questionnaire (Appendix 1) applying snowball sampling technique, considering a household with more than 0.2 ha of farmland in three urban pockets as a sampling unit; visual observation by using structured observation-sheet (Appendix 2); and key informant/ focus group discussion using discussion checklist (Appendix 3) to collect primary information in the selected pockets. The total number of households' surveyed, visual observations and key informant/ focus group discussions were carried out as shown in the following table (Table 1).

Table 1. Interviews, observations and key informant/focus group discussions carried-out in the study process

SN	Location (Pocket)	Household interviews	Observation sheets	F.G./Key informant discussion
1	Saraswoti (P1)	20	20	3
2	Chandeshwori (P2)	24	24	2
3	Sapnatirtha (P3)	20	20	1
Total		64	64	6

Key informant interviews and focus group discussions were conducted in the concerned subject, considering the VDC/ward representatives, leader farmers and school teachers as the key informants for this study. The questionnaire, checklists and observation-sheet were prepared covering the aspects required to fulfill the objective of the study.

3.5 Conceptual framework of the study

The conceptual framework of the study was outlined as follows describing the theoretical background of different aspects of the study and the tools used for the analysis.

3.5.1 Analysis of sample households

The study made attempts to analyze the patterns of the farm households under study area in terms of household characteristics, landholding patterns and employment patterns of the farm households surveyed in the study area as under.

Household characteristics

The characteristics of the sample farm households in the study area was described based on the observed data and information obtained from the farmers' interviews and the researcher's observation basically on the family size, housing types (roofing patterns) and awareness (training obtained) in the agricultural technology.

Landholding pattern

Landholding pattern of the farm families in the study area was described based on the data and information obtained from the sample survey. Based on the observed data, the average size of landholding (owned as well as rented land for cultivation) by the farm households was calculated with comparative analysis in the selected pockets under the study. The variations in the landholding patterns was also analyzed by means of two way analysis of variance (ANOVA), along with the hypothesis testing applying F-test using statistical software (MSTATC).

Employment pattern

A gender wise comparative employment pattern of the farm families in the three selected pockets under the study was analyzed. Based on observation, the variation in employment (%) was computed and farmers' responses in this concern were analyzed by testing hypothesis applying Chi Square technique (χ^2-test).

3.5.2 Major crops and cropping pattern

The major crops and cropping pattern in the study area was analyzed based on the information obtained from the sample survey (semi-structured interviews) using structured questionnaire (Appendix 1), visual observation by the researcher using structured observation-sheet (Appendix 2), key informant survey and focus group discussion using a discussion checklist ((Appendix 3). The major types of crops and growing patterns in the area were presented by means of figures and tables. Two-way analysis of variance (ANOVA-2) was worked out to analyze the variations in crop production over locations and households.

3.5.3 Livestock and poultry production pattern

Livestock and poultry production pattern in the study area was analyzed based on the information obtained from the sample survey (semi-structured interviews) using structured questionnaire (Appendix 1), visual observation by the researcher using structured observation-sheet (Appendix 2), key informant survey and focus group discussion using a discussion checklist ((Appendix 3). ANOVA-2 was worked out to analyze the differences in domestication of livestock and birds over location and households.

3.5.4 Attitude of the urban people towards agricultural occupation

Attitude of the urban people towards agricultural and no-agricultural occupation functions was analyzed by the sample survey. Comparative employment patterns of the farm families in the three selected pockets were described by tabulating variation the farmers' responses on different sectors of occupation- agriculture, service, trade/business, waged labor and foreign employment. The response of the farmers to the agriculture as an occupation in the three pockets was recorded as in one of the four categories- full employment, partial employment, additional income source and means for using spare

time. The hypothesis regarding to the variation in agricultural practice in terms of income and employment was tested applying Chi Square technique, fitting the observed data into 4X3 contingency table.

3.5.5 Supply of nutrition to the urban farmers

The maximum occurrence pattern of nutrient supply to the urban farmers was calculated in percentage, based on 1-3 scoring (1=sometimes; 2=often; 3=always) to the occurrence of three different nutrient supply patterns, namely- purchasing from others, consuming own product and selling over surplus. The observed scenario regarding to the variation in nutrient supply pattern among the farm families was described by means of table and Pie charts.

3.5.6 Agricultural problem ranking and development priority

Ranking of problems related to agriculture was carried out from farmers' perspective through 1-7 point based scoring to different problems related to agriculture. Analysis of the agricultural problem ranking from the farmers' perspective was carried out by means of scoring index as under (Table 2).

Table 2. Scoring index followed in agricultural problem ranking in the present study.

Obtained score	Given value (mark)	Obtained score	Given value (mark)
1	7	5	3
2	6	6	2
3	5	7	1
4	4		

The farmers' priority to different development functions in the study area was determined by means of priority scoring from the respondent farmers, based on 1-6 point scoring for different development functions, followed by the analysis of the farmers' priority to different development functions by using scoring index as under (Table 3).

Table 3. Scoring index followed in the analysis of the farmers' priority to different development functions in the study area.

Obtained score	Given value (marks)	Obtained score	Given value (marks)
1	6	4	3
2	5	5	2
3	4	6	1

Agricultural problem index (API) and development priority index (DPI) were calculated applying the relationship as under (Equation 1 and 2).

$$API = \frac{\sum_{i=1}^{n} Pi}{n.S\max} \times 100\% \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where,

API = Agricultural problem index

$\sum$ = Summation

P_i = Problem component score index

n = Total number of components observed

S_{max} = Maximum possible score(s)

Similarly,

$$DPI = \frac{\sum_{i=1}^{n} Di}{n.S\max} \times 100\% \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where,

DPI = Development priority index

$\sum$ = Summation

D_i = Component priority score index (average marks obtained)

n = Total number of components observed

S_{max} = Maximum possible score(s)

3.5.7 Resource recycling pattern

Resource recycling pattern in the three selected urban agriculture pockets were analyzed based on the data and information obtained from the household interviews and observations, especially on the farmers' practice on bio-gas, composting toilet, vermi-composting practice, in-situ or green manuring practice and waste water utilization. Resource recycling index (RRI) was determined from the following empirical relationship (Equation 3).

$$RRI = \frac{\sum_{i=1}^{n} Si}{n.S\max} \text{ X } 100\% \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (3)$$

Where,

RRI	=	Resource recycling index
$\sum$	=	Summation
S_i	=	Component score index
n	=	Total number of components observed
S_{max}	=	Maximum possible score(s)

Two-way analysis of variance (ANOVA-2) was worked out to analyze the variations in the resource recycling index (RRI) in the three selected urban agriculture pockets under study.

3.5.8 Crop pest management practice

Crop pest management practice in the study area was described based on the farmers' response during the interview. The farmers' responses in terms of doing nothing, using chemical pesticides, using bio/botanical pesticides, adopting IPM practice and traditional system of pest management were compiled and presented in the form of table or figure with the help of computer software.

3.5.9 Production trend in agriculture

The farmers' responses with regard to the production trend in agriculture was compiled and tabulated using spreadsheet (Excel) program, followed by diagrammatic representation. Analysis of variance (ANOVA) was worked out for rice production, wheat production, maize production, vegetable production, buffalo farming, cattle farming, goat farming, poultry farming and duck production.

3.5.10 Analysis of surrounding environment

The surrounding environment in each of the selected study pockets was analyzed based on the visual observation by the researcher. The observed frequencies of field, forest, human settlement, ponds, stream, etc were recorded per observation. The observed

data in this regard was compiled and presented in the form of table and/or figure with respect to the study pockets comparatively.

3.5.11 Agricultural service and facilities

Agricultural service and facilities available in the three selected study pockets was comparatively analyzed based on observation and discussion, especially in terms of irrigation facilities, market facilities and the access to agricultural extension service/facilities. Methods described by Pradhan (2003) was followed to work-out development infrastructure index, triangulated agricultural facility function scalogram and triangulated agriculture input use function scalogram with regard to the three pockets under study. Market facility and the access to agricultural extension service have been analyzed applying two-way ANOVA through statistical software (MSTATC).

3.5.12 Organizations supporting to agriculture

The organizations involved in supporting to agricultural development activities in the study area has been described based on the farmers' responses, key informant interviews and focus group discussion on the concerned topic and secondary sources of information including publications. Access to institutional and infrastructural services was analyzed by means of informative table(s) and/or diagram(s).

3.5.13 Agricultural integration potentials

Agricultural integration potentials in the selected study area was determined by means of observed scores on different agricultural enterprises and calculated in percentage. Integrating the specific agricultural component was considered potential if the component was frequently recorded. Comparative frequencies of the different agricultural enterprises observed in the study pockets have been presented with help of tables and/or pie charts.

3.5.14 Relation between different agricultural parameters

MULTIREG (Multiple Regression) function was worked out to analyze the relationship between the different agricultural parameters in the present study. With the help of this function using the statistical software (MSTATC), correlation matrix was

carried out among the parameters like landholding, cereal productivity, vegetable productivity and irrigation problem index. Similarly, correlation matrix was worked out among the parameters like women in farming, men in farming, agricultural production trend, urban facility, commercial production, etc along with the analysis of variance (ANOVA) over regression and residual.

3.6 Data Processing and analysis

This study is based on primary data collected through the formal field survey. Relevant secondary data and information are also used to facilitate the analysis, along with primary information. All the information collected during study process, including qualitative information were coded and tabulated. Statistical tools and techniques (**Appendix 16**) were employed for appropriate processing and analysis, further supplemented by different computer software packages like WORD, EXCEL, MSTATC /SPSS.

3.7 Organization of the Study

The study was divided into 3 phases. The first phase included the preparation of research proposal with the conceptual framework of the study. The second and the most important phase included the execution of the survey (field work). This included the preparation of questionnaire, observation sheet and discussion checklist; followed by pre-testing, correction and data collection. This also included the collection of relevant secondary information. At the third (final) phase, data processing and analysis, including computer data processing were carried out along with interpretations and inferences. The Thesis has been arranged into five chapters. Chapter One deals with the general introduction of the work. Chapter Two includes the review of relevant literature. Chapter Three explains the research methodology followed. Chapter Four presents the results of the study along with brief discussion. And, at the last, Chapter Five summarizes the thesis with conclusions and recommendations for further study.

Chapter Four

RESULTS AND DISCUSSIONS

The study explains the urban agriculture as the means of increasing income, employment and nutrient supply including socio-economic and institutional implication. This also analyzes the attitudes of the urban people with regard to increasing agricultural production, with identification of the organizations involved in supporting to agricultural development activities in Tokha area. The major highlights of the study include the following.

4.1 Analysis of sample households

The socio-economic patterns of the area covered by the study includes household characteristics, landholding patterns and employment patterns which has been outlined, based on the survey, as under.

4.1.1 Household size and types of houses

The study shows that the overall average family size in the sampled households in the study area was 7.75 people per household (Saraswoti 9.50, Chandeshwori 6.71 and Sapnatirtha 7.25). The study reveals that the majorities of the houses in the study area include the zinc sheet roofing houses (46.91%), followed by RCC/RBC (34.57%) and tiled roofing (13.58%) types. Table 4 shows the major housing types (roofing patterns) in the study area.

Table 4. Housing types (roofing patterns) of the farm households in the study area.

Housing (Roofing) type	Number of houses			
	Saraswoti (HH=20)	Chandeshwori (HH=24)	Sapnatirtha (HH=20)	Total (HH=64)
RCC/RBC	12 (41.40)	14 (45.16)	2 (9.52)	28 (34.57)
Zinc sheet roofing	11 (37.90)	11 (35.48)	16 (76.19)	38 (46.91)
Straw (Khar/Seula) roofing	0 (0.00)	1 (3.23)	1 (4.76)	2 (2.47)
Khapta roofing	2 (6.90)	0 (0.00)	0 (0.00)	2 (2.47)
Tiled roofing	4 (13.80)	5 (16.13)	2 (9.52)	11 (13.58)
Total	29 (100.00)	31 (100.0)	21 (100.0)	81 (100.0)

- The figure in parentheses indicates percentage of total houses.
- The total numbers of houses exceed the number of HH surveyed as some families have more than one house of same or different types.

Assessment of the awareness level of farmers on improved agricultural technology in the study area indicates that majority of the farm families are not trained in modern agricultural techniques. Figure 4.1 describes the comparative awareness level of the farm families in the study area on improved agricultural technology.

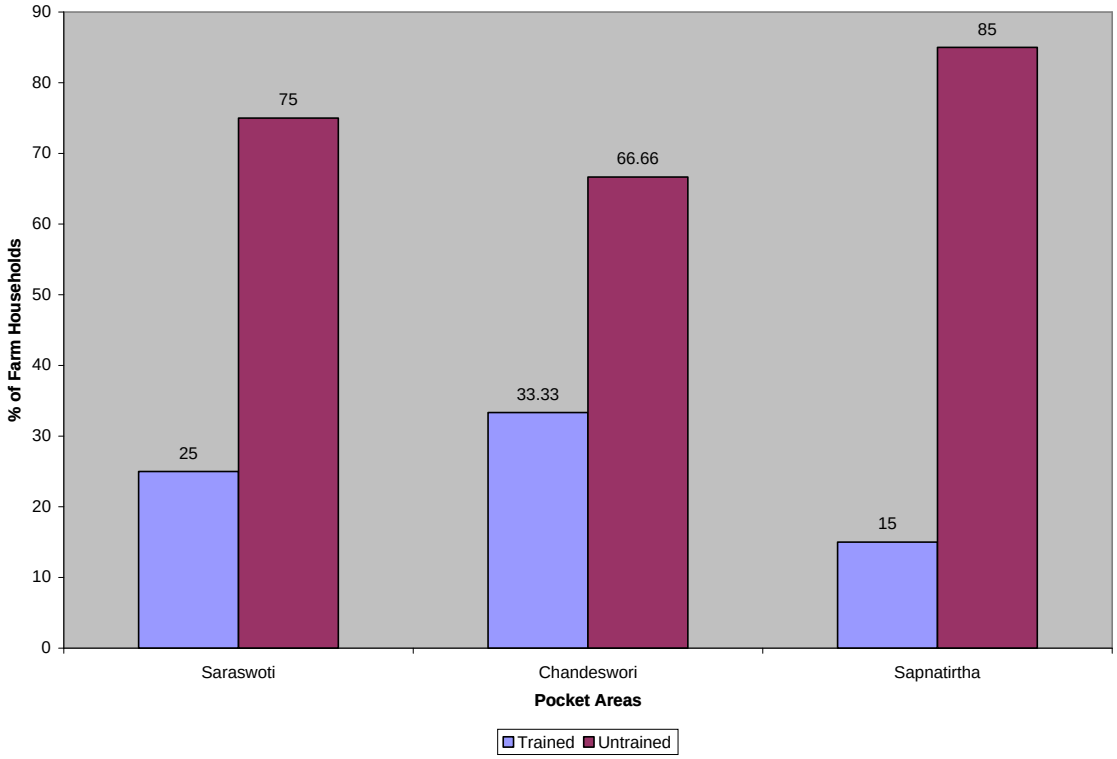


Figure 4. Awareness level of the farm families on improved agricultural technology, Tokha, 2006.

Very few farm family members have obtained training on modern agricultural technology. The subjects at which they obtained training include goat/sheep farming, mushroom cultivation, vegetable production, beekeeping and so on. The institutions or agencies providing training to the farmers in the study area include DADO/ DLSO, Women Development Office, Village Development Committees, etc.

4.1.2 Employment pattern

Based on observation, the variation in employment (%) was computed and farmers' responses in this concern were analyzed. The principal sectors of employment in the study area were agriculture, service sector, trade/business, waged labor and foreign

employment. Table 5 describes the gender wise comparative employment patterns of the farm families in the three selected pockets under the study.

Table 5. Employment patterns of the farm families in Tokha, 2006.

Sector	Variations in employment (%)								
	Tokha Sarawoti (HH = 20, n = 190)			Chandeshwori (HH = 24, n = 161)			Sapnatirtha (HH = 20, n = 145)		
	Female	Male	Total	Female	Male	Total	Female	Male	Total
Agriculture	25.26 (48)	25.79 (49)	51.05 (97)	29.81 (48)	22.36 (36)	52.17 (84)	25.52 (37)	20.69 (30)	46.21 (67)
Service sector	2.10 (4)	4.21 (8)	6.31 (12)	1.24 (2)	1.24 (2)	2.48 (4)	0.00 (0)	3.45 (5)	3.45 (5)
Trade/business	1.58 (3)	4.44 (4)	3.68 (7)	1.24 (2)	4.35 (7)	5.59 (9)	0.00 (0)	0.69 (1)	0.69 (1)
Waged labor	1.05 (2)	7.37 (14)	8.42 (16)	0.00 (0)	7.45 (12)	7.45 (12)	1.38 (2)	8.97 (13)	10.35 (15)
Foreign employment			3.16 (6)			4.35 (7)			1.38 (2)

- HH= The total number of household surveyed;
- n = Total population surveyed.
- The figures in the parentheses are the total observed figures.
- Percentage figures indicate the percent of total population surveyed.

The hypothesis regarding to difference in employment patterns in terms of 5 employment options (agriculture, service sector, trade/business, waged labor and foreign employment) was tested applying Chi square test, fitting the observed occupational data into 5X3 contingency table (Appendix 4). The observed χ^2 value was not significant at 5% level (Observed χ^2 value 11.036; table value of χ^2 at 5% level and 8 degrees of freedom 15.51). The analysis, thus, comes to the conclusion that the variations in employment opportunities in terms of agriculture, service sector, trade/business, waged labor and foreign employment, in general, was not significant in the three selected urban pockets. Thus, the study reveals the substantial role of women in the urban farming system in Tikha area, which is likely with the study results reported by Timsina (1992). And, likely with the report of Devkota and Rauniyar (1999), the findings supports the hypothesis that differences in gender and ethnic roles need to be accounted for urban agricultural policy formulation and planning.

4.1.3 Landholding pattern

Maximum size of landholding was observed to be 60 Ropany and most of the land was un-irrigated upland. Landholding pattern in the three pockets of study area has been comparatively described by means of a bar diagram as under (Figure 5).

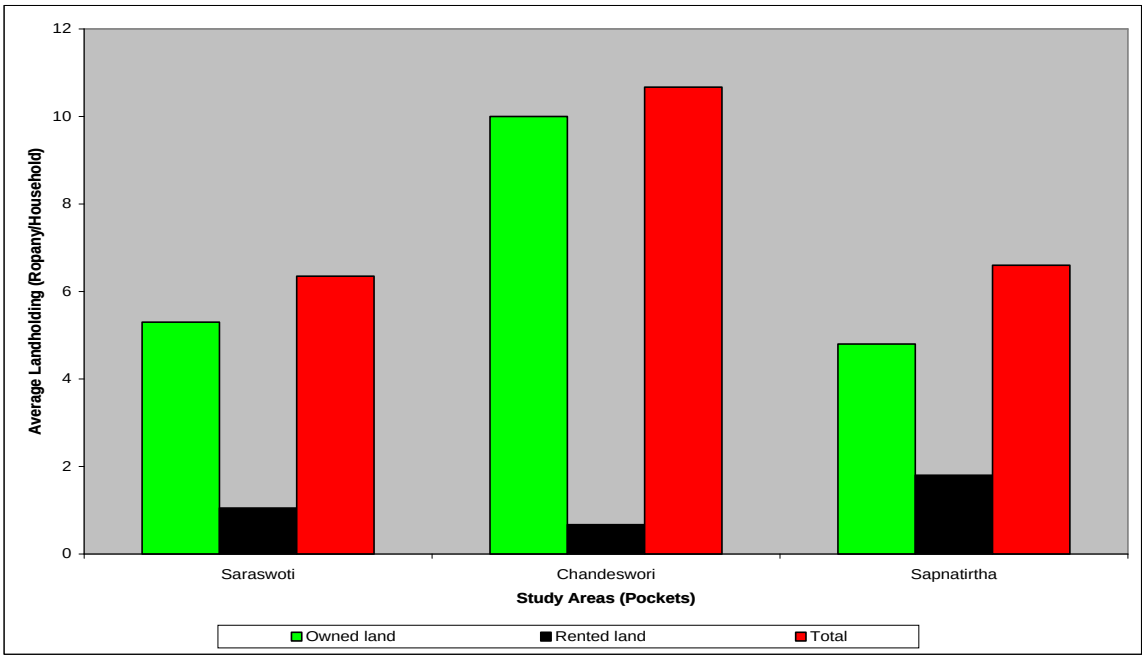


Figure 5. Average landholding patterns in the three pockets of Tokha area.

Two way analysis of variance (ANOVA-2) for the observed data on land holding shows that the variance of the total landholding (owned + rented) by the farmers in the study area over the three locations was not significant (P-value= 0.0649). However, the variation in the owned land over the three study locations was significant, with P-value= 0.0191 (Appendix 5, variable 1). The grand means for owned, rented and total landholding revealed by the study were 6.167, 1.083 and 7.167 Ropanies respectively. Thus, in terms of landholding patterns in the study area, inequalities were observed. This finding is likely with the findings observed by the study of Thapa (1991) on income inequality in rural Nepal.

4.2 Attitude of the urban people towards agricultural occupation

The variations in the employment patterns of the urban people in terms of agriculture and non-agricultural occupation functions revealed from the study has been

described earlier and presented in the Table 5. Farmer's responses with regard to agriculture as a profession were tested by collecting and analysis of data on their engagement pattern in agriculture. Majority of the farmers responded that agriculture was the principal source of income and employment for their family. Table 6 describes the variation in the responses of the farmers in this regard as revealed by the study.

Table 6. Farmers' responses to agriculture in terms of employment.

Response to agriculture	Frequencies of farmers (%)			
	Saraswoti, **P_1**, (n=20)	Chandesori, **P_2**, (n= 24)	Sapnatirtha, **P_3** (n =20)	Mean (n =64)
As full employment	35.00 (7)	54.17 (13)	55.00 (11)	48.44 (31)
As partial employment	50.00 (10)	41.67 (10)	45.00 (9)	45.31 (29)
As additional income source	10.00 (2)	4.17 (1)	0.00 (0)	4.69 (3)
As means for using spare time	5.00 (1)	0.00 (0)	0.00 (0)	1.56 (1)

The figures in parentheses are the total observed figures.
P_1 = Accessible pocket, nearby town.
P_2 = Less accessible pocket with human settlement.
P_3 = Isolated pocket

The hypothesis regarding to difference in agriculture in terms of income and employment was tested applying Chi square test, fitting the farmers' responses into a 4X3 contingency table (Appendix 6). The observed χ^2 value was highly significant at 1% level (Observed χ^2 value 26.76, table value of χ^2 at 1% level and 6 degrees of freedom 16.81). The analysis, thus, comes to the conclusion that the access to facilities including road and market is conducive to the farmers for searching other alternatives to agricultural occupation. As a result, there might be low percentage of households having agriculture as full employment and more people adopt agriculture as partial employment but market oriented production. Contrary to this, if the pocket is isolated with less access to facilities required, higher percentage of people remain in subsistence agriculture with lesser search for other alternatives and market oriented production.

4.3 Major crops and cropping pattern

The major crops grown observed and reported in the study area include paddy, wheat, maize, potato, sugarcane, millet, chilly, onion, garlic other vegetables and very few fruits. In Tokha area, very few fruit crops were observed, except in the Chandeswori

area, where some farmers are growing some fruits. Relatively, the crops observed or reported to be grown in the three pockets studied in Tokha have been presented in figure 6. Major cropping patterns being adopted in the study area has been presented in Table 7.

Figure 6. Major crop types grown in Tokha area.

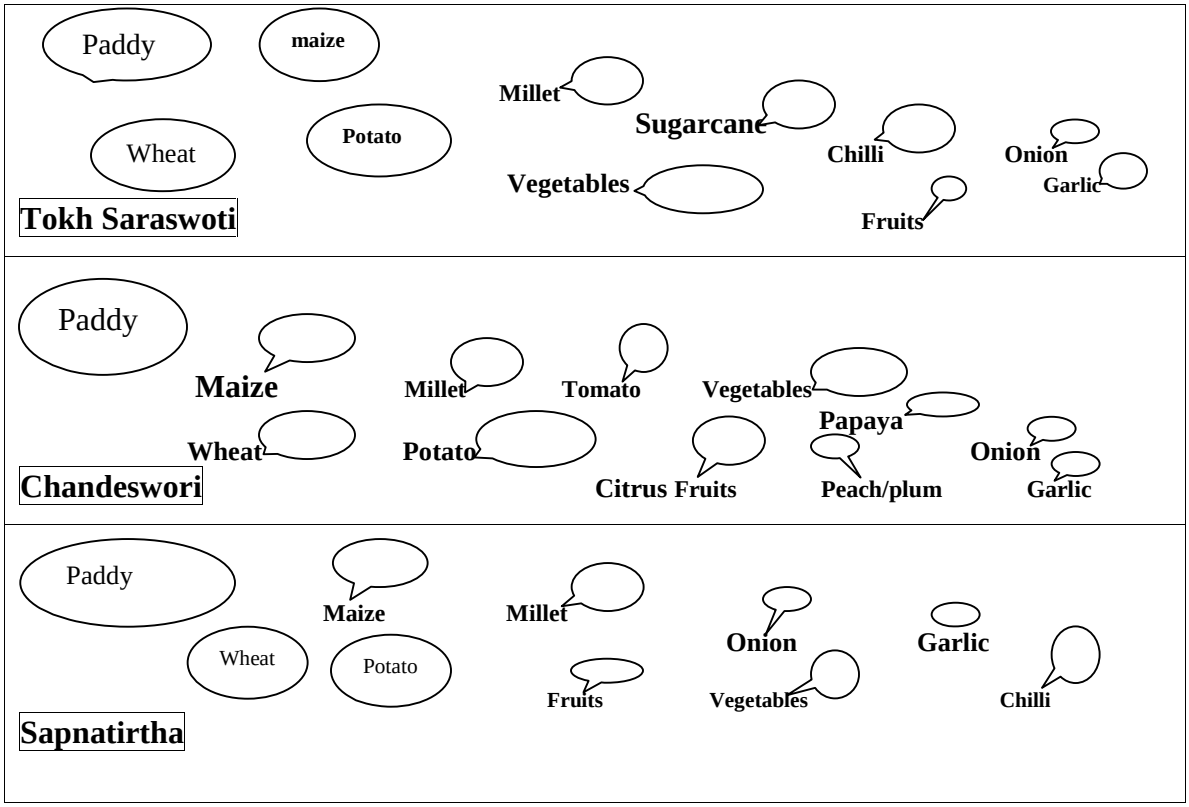


Table 7. Major cropping patterns adopted by the farmers in Tokha

Study Area	Major Cropping Patterns	
	Lowland	**Upland**
Sarasoti	⁾ Paddy - Wheat ⁾ Paddy – Wheat – Maize	⁾ Maize– Paddy (Ghaiya)- Millet ⁾ Maize – Vegetables ⁾ Maize - Millet
Chandeswori	⁾ Rice – Wheat ⁾ Paddy – Vegetables ⁾ Paddy – Wheat - Potato	⁾ Maize – Millet ⁾ Maize - Paddy (Ghaiya) ⁾ Fruits (Citrus fruits, Papaya, Peach/Plums, Pear, etc.)
Sapnatirtha	⁾ Paddy – Wheat ⁾ Paddy – Potato	⁾ Maize – Millet ⁾ Maize - Wheat

Two way analysis of variance (ANOVA-2) over locations (variable 1 with values from 1 to 3) and households (variable 2 with values from 1 to 24) shows significant variations in terms of production of paddy (P-value =0.006), wheat (P-value =0.0052), potato (P-value =0.0002) and vegetables (P-value =0.0372) exist in the three locations of study (Appendix 5). Whereas, the difference in the production of maize (P-value =0.2542) was observed not significant over the three locations. The variations observed in the production trend of the major crops in the three study areas has been presented in the Appendix 5 along with the observed means and coefficient of variation (C.V. %). The variations in the production of vegetables in the three study area is significant, but the production is only limited to household consumption and no significant commercialization (P-value =0.5102) was observed in terms of vegetable farming (Appendix 5, Variable 22).

4.4 Livestock and poultry production

Major livestock and birds domesticated in Tokha area include buffalo, cattle, goat, sheep, poultry and ducks. Based on the observation, relative abundance of different animals and birds domesticated in the three study pockets of Tokha area has been presented in Figure 7.

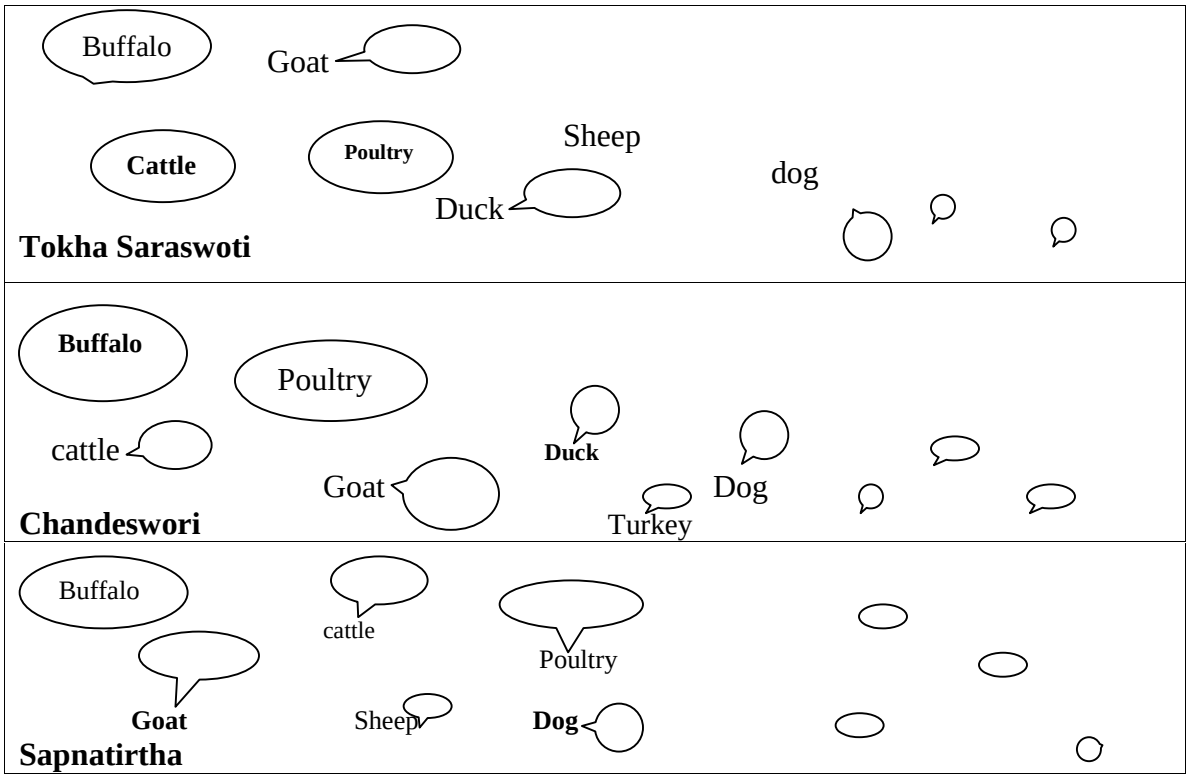


Figure 7. Major livestock and birds types in the Tokha area.

The variations in the numbers of domesticated livestock and birds observed in the study area was found not significant while analyzing with the help of two way analysis of variance (ANOVA-2) over the location treatment and the household as replication units (Appendix 5).

4.5 Supply of nutrition to the urban farmers

The study shows that 39% of the urban farmers fulfill their nutrition requirements from their own farm products and 19% of the farm families are selling over their surplus farm products (Figure 8).

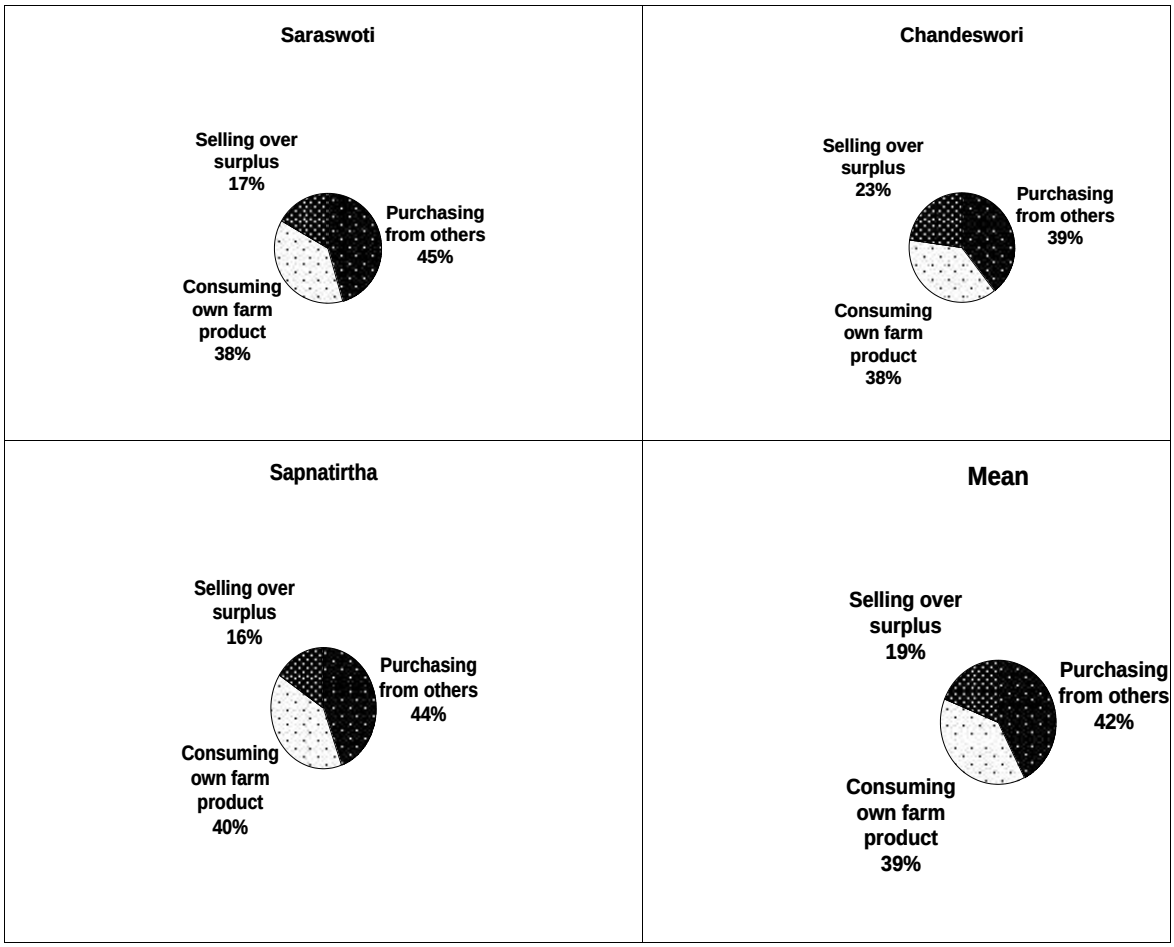


Figure 8. Contribution of farm products in the nutritional supply of urban farmers.

The survey reveals that 15.6% of the farmers in the study area have not knowledge about nutrition requirements. The observed data on the nutrient supply patterns to the urban farmers strongly supports the hypothesis that nutrient required to the poor urban farmers are basically supplied from the farm products. Table 4.5 describes the patterns of nutrition supply to the urban farmers in the study area.

Table 8. Patterns of nutrition supply to the urban farmers in the study area.

Nutrient Supply Pattern	Maximum Occurrence (%)			
	Saraswoti, **P_1**, (n = 20)	Chandesori, **P_2**, (n = 24)	Sapnatirtha, **P_3**, (n = 20)	Mean
Purchasing from others	68.30	75.00	83.67	75.38
Consuming own farm product	56.70	72.00	75.00	68.20
Selling over surplus	25.00	43.06	30.00	33.33

The study shows the general patterns of nutritional supply to urban farmers in Tokha. Similar type of study carried out in Chitwan suggests that social and economic variables such as size of landholding, income and employment structure of households are positively related to the nutritional status (Bhandari, 1985).

4.6 Resource recycling pattern in agriculture

Resource recycling pattern in the three selected urban agriculture pockets were analyzed based on the observed, especially on the farmers' practice on bio-gas, composting toilet, vermi-composting practice, in-situ manuring practice and waste water utilization. Resource recycling index (RRI) has been determined and presented in Table 9.

Table 9. Resource recycling practices in agriculture observed in Tokha, 2006.

Resource Recycling Agricultural Functions	Practiced Household (respondent %)			Mean (%) n=64
	Saraswoti (P_1), n=20	Chandeswori (P_2), n=24	Sapnatirtha (P_3), n=20	
Biogas use	10.0 (2)	8.3 (2)	0.0 (0)	6.3 (4)
Composting toilet	35.0 (7)	4.2 (1)	5.0 (1)	14.1 (9)
Vermi-compost use	0.0 (0)	0 (0)	0.0 (0)	0.0 (0)
In-situ manure use	5.0 (1)	0 (0)	0.0 (0)	1.5 (1)
Household waste water utilization	35.0 (7)	58 (14)	60.0 (12)	48.4 (31)
Resource recycling index (RRI)	**17.0 (0.17)**	**14.1 (0.141)**	**13.0 (0.13)**	**14.0 (0.140)**

The figures in the parentheses are the observed figures

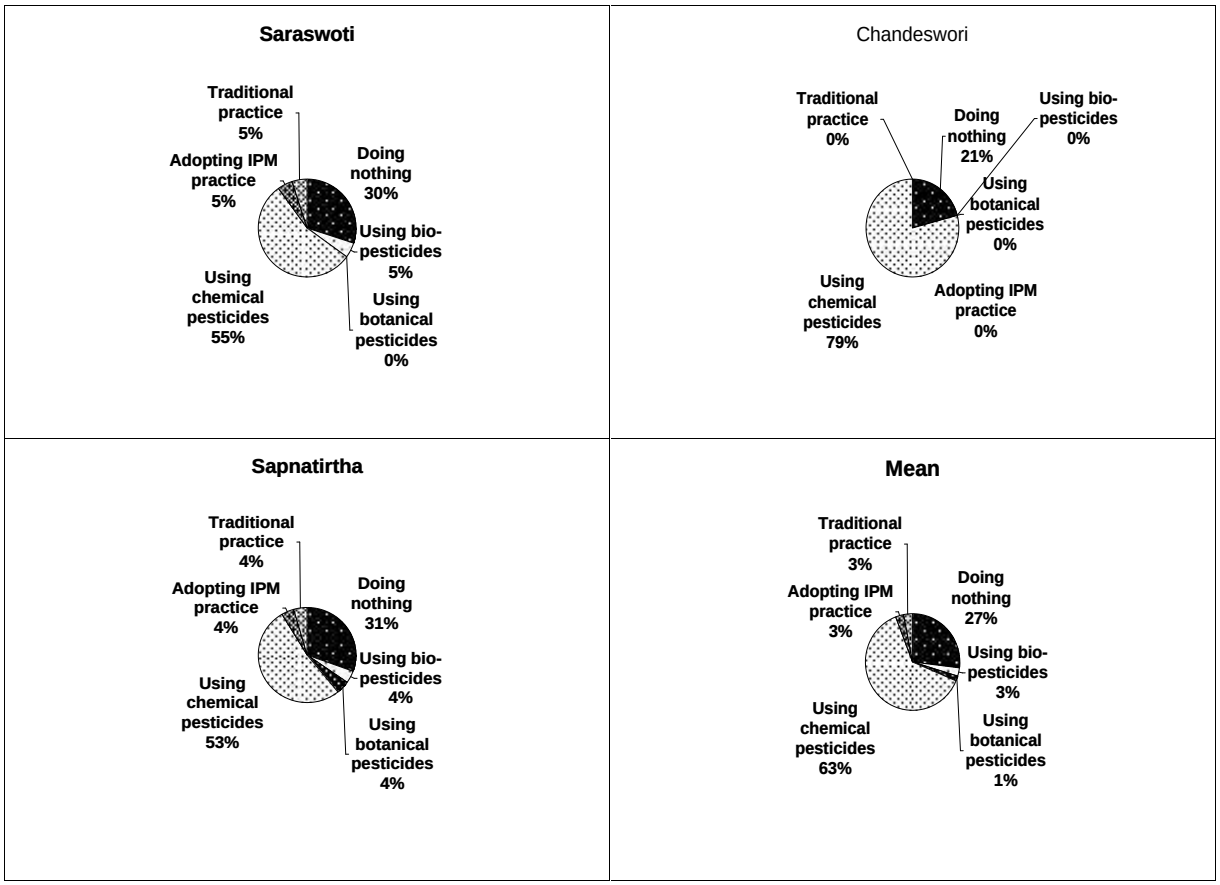
Two-way analysis of variance (ANOVA-2) was worked out to analyze the variations in the resource recycling index (RRI) in the three selected urban agriculture pockets under study (Appendix 9, variable 21). The analysis supports the hypothesis that there is no significant difference in the resource recycling index (RRI) of the three locations of the study area (P–value = 0.5502).

4.7 Crop pest management practice

The analysis farmers' responses in terms of crop pest management practice adopted by them in the study area indicates that majority of the farmers (65.8%) use

chemical pesticides to control crop pests and diseases. Whereas, 29.6% farmers do nothings for pest management and very few farmers are adopting IPM (Integrated Pest Management) practice (Figure 9).

Figure 9. Crop pest management practices in Tokha



4.8 Production trend in agriculture

Agricultural productivity in the study area seems to be decreased as compared to the production in the past. Among the 64 farm households surveyed, 75% of the farmers responded that their farm production is in decreasing trend. Whereas, 12.5 % responded that agricultural production is increasing, and, 12.5% responded that there is no any change in agricultural productivity. The comparative responses of the farmers' with regard to production trend in agriculture in the three pockets have been depicted in the Figure 10.

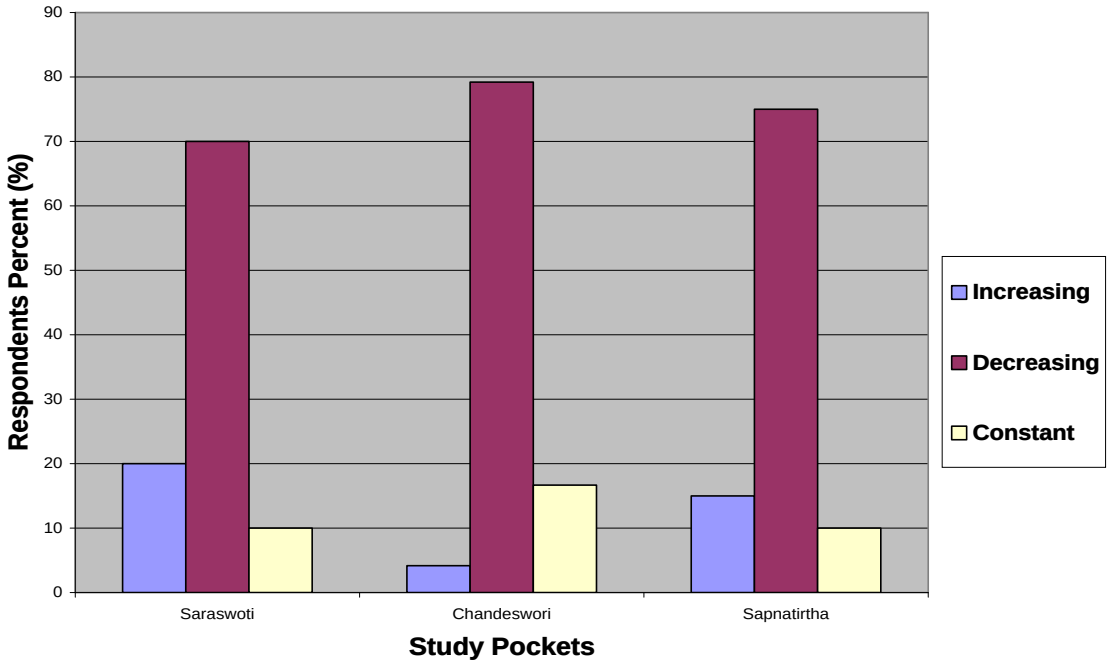


Figure 10. Responses of the farmers' with regard to production trend in agriculture

4.9 Agricultural development services and facilities

Agricultural service and facilities available in the three selected study pockets was comparatively analyzed based on observation and discussion, especially in terms of facilities and services. The development of the study area was measured and analyzed in terms of infrastructure index, which was built on the basis of logical expression of 1 and 0 for the presence and absence of the facilities respectively (Table 10).

Table 10. Development Infrastructure Index Observed in Tokha, 2006.

Study Center	Infrastructure Types											Total	Mean Index
	RH	TS	EL	DW	CO	AE	VT	HS	IF	MF	BK		
Saraswoti	1	1	1	0	1	1	1	1	0	1	0	8	0.73
Chandeswori	0	1	1	1	1	0	0	1	1	0	0	6	0.55
Sapnatirtha	0	1	1	0	0	0	0	0	1	0	0	3	0.27
Sum	1	3	3	1	2	1	1	2	2	1	0	17	0.51

RH= Road head, TS= Transport service, EL= Electricity, DW= Drinking water, CO= Cooperatives, AE = Agricultural extension, VT= Veterinary, HS= High School, IF= Irrigation facility, MF= Market facility, BK= Banks.

Thus, based on the infrastructure index observed, Tokha Saraswoti was comparatively better facilitated area among the three pockets, whereas Sapnatirtha was observed and grouped as least facilitated. Table 11 describes agriculturally specific and comparative service and facility functions available in the study area, whereas, the comparative agricultural input use patterns in the three pockets has been presented in Table 12.

Table 11. Triangulated Agricultural Facility Function Scalogram

Location	SFHH	Agricultural Service/Facility Availability Function							
		CNL	TWI	RK	AGV	AES	PND	SDA	RA
Saraswoti	20	X	X	X	X	X	X	X	X
Chandeswori	24	X	X	X	X				
Sapnatirtha	20	X	X						

SFHH = Survey farm households, CNL= Irrigation Canal, TWI = Tube well irrigation, RK = *Raj Kulo*, AGV = Agrovet center, AES = Agriculture extension service, PND= Ponds, SDA = Shops dealing agro-products, RD = Road access.

Table 12. Triangulated Agricultural Input Use Function Scalogram, Tokha, 2006

Location	SFHH	Agricultural Resource Use Function						
		CHF	CMP/FYM	CHP	VTM	BG	GRM	IPM
Saraswoti	20	X	X	X	X	X	X	X
Chandeswori	24	X	X	X	X	X		
Sapnatirtha	20	X	X	X				

CHF = Chemical fertilizer, CMP = Compost, FYM = Farm yard manure, CHP = Chemical pesticides, VTM = Veterinary medicines, BG = Biogas plants, GRM = Green manure, IPM = Integrated Pest Management Practice.

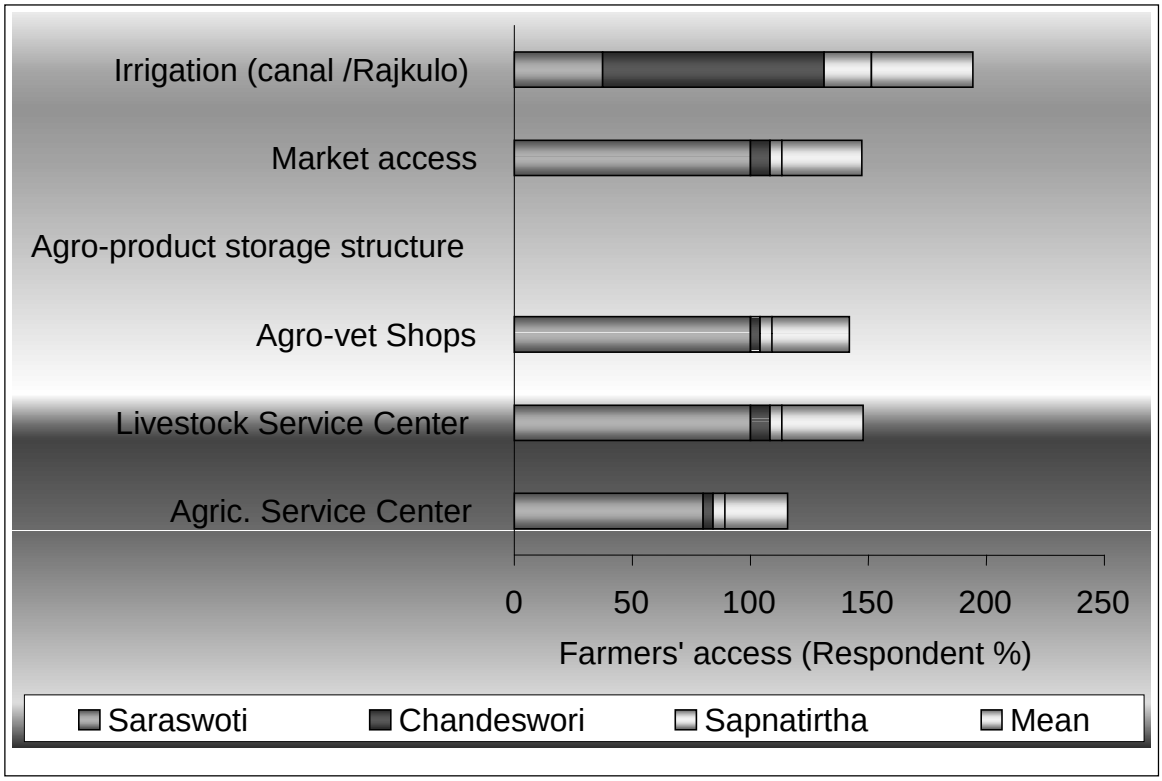
4.10 Organizations supporting to agriculture

Different governmental and non-governmental organizations are involved in supporting agriculture development activities in the urban periphery. The study reveals that the major governmental institutions supporting to agricultural development in Tokha includes Agricultural Service Center (ASC/DADO) and Livestock Service Center (LSC/DLSC). However, due to the present conflict conditions, the service provided by the governmental institutions seems to be very limited. As the local governmental

institutions, Village Development Committees (VDCs) also support to agricultural development activities in Tokha, especially in providing training and other service supports to promote agricultural development. Besides, different NGOs, including UNICEF and Plan International, also conducted different support programs for agricultural development in the past. At present, no significant impacts of NGOs were observed. At local level, different clubs, Guthies, Women Groups and Cooperatives, Community Forest User Groups, Local Saving and Credit Cooperatives and so on are presently involved in supporting, awareness and self-help activities in the study area.

The study analyzed the access of agricultural extension services, organizations and infrastructures for local farmers to facilitate their farming activities. In the overall scenario, very limited institutional and infrastructural supports to the local people were reported. Figure 11 describes the existing access of agricultural service institutions and infrastructures to the local people based on the observations, farmers' perspective and perceptions.

Figure 11. Farmers' access to institutions and infrastructures related to agricultural development in Tokha



Thus, the study shows that the access to organizations, institutions and infrastructures related to agricultural development in Tokha are limited only in the urban center. The farmers in the hinterlands and isolated pockets are still disadvantaged and excluded. Analysis of variance (ANOVA) for farmers' access to agricultural extension service in the study area shows that there is a significant variations (P-value = 0000) in the three locations in terms of the farmers' access to agricultural extension service and facilities (Appendix 5). This result is likely with the finding described by Dongol and Intedio (1985) in which the frequency of contact with different source of information was found associated with the extent of adoption of improved agricultural practices.

4.11 Agricultural integration potentials

The study reveals that there are immense potentialities for agricultural development in Tokha if the resource base, institutions and infrastructures required organized properly in a coordinated and consolidated manner. However, the present agricultural scenario in the location seems to be traditional. Modern agricultural technologies are not so much introduced and/or adopted in Tokha. Based on observation and collection of farmers' response, the present study analyzed the integrated agricultural development potentialities in the area. Figure 12 indicates the overall integrated agricultural development potentialities in the study area.

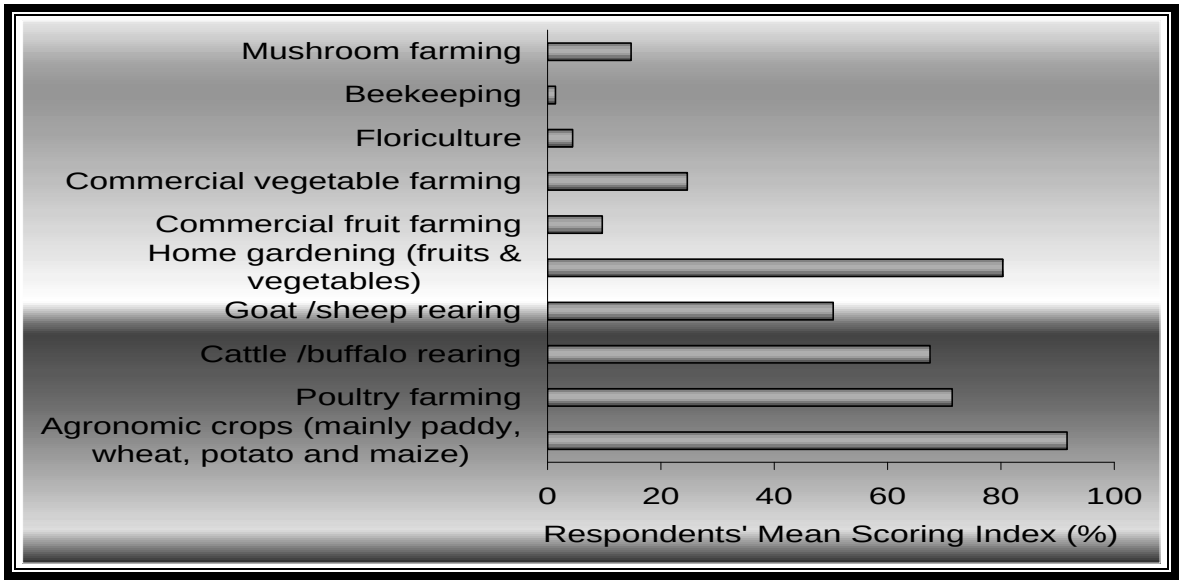


Figure 12. Agricultural potentiality indices in Tokha based on farmers' responses

Moreover, Table 13 describes the comparative potentials of agricultural integration in the three selected study areas based on farmers scoring indices in the respective agricultural component enterprise. The study shows that the highest potentiality in the areas include growing agronomic crops (mainly paddy, wheat and potato and maize), followed by integrating livestock and poultry farming.

Table 13. Agricultural integration potentials in the Tokha area.

Agricultural Enterprises	Observed Score (Respondent %)			
	Saraswoti, $P_{1,}$ (n = 20)	Chandeswori, P_2, (n = 24)	Sapnatirtha, P_3, (n = 20)	Mean
Agronomic crops (mainly paddy, wheat, potato and maize)	75.00	100.00	100.00	91.66
Poultry farming	70.00	79.20	65.00	71.40
Cattle /buffalo rearing	65.00	75.00	62.50	67.50
Goat /sheep rearing	52.5	56.25	42.5	50.40
Home gardening (fruits & vegetables)	80.00	91.00	70.00	80.33
Commercial fruit farming	0.00	29.20	0.00	9.66
Commercial vegetable farming	30.00	29.00	15.00	24.66
Floriculture	5.00	8.30	0.00	4.43
Beekeeping	0.00	4.20	0.00	1.40
Mushroom farming	35.00	4.20	5.00	14.73

4.12 Relation between different agricultural components

Analysis was carried out to establish relationship among the agricultural parameters in the study area by applying MULTIREG function using the statistical software (MSTATC). Correlation and regression analysis was carried out among the parameters like landholding, family size, engagement in agricultural occupation, owned and rented landholding, agricultural production trend, market facilities, access to agricultural extension and commercialized vegetable farming. The relationship between different parameters related to agriculture observed in the study area has been presented in the Table 14.

Table 14. Correlation coefficient matrix among different agricultural parameters.

	Women in farming	Men in farming	Agricultural production trend	Urban facility	Commercial production
Women in farming	1.00				
Men in farming	-0.28 *	1.00			
Agricultural production trend	-0.04	0.19	1.00		
Urban facility	0.22	-0.34 **	-0.25 *	1.00	
Commercial production	0.31 *	0.32 *	-0.12	0.23 *	1.0

(Function: MULTIREG; Data case: 1 to 64)

* Significant at 0.05 level and 63 degrees of freedom

** Significant at 0.01 level and 63 degrees of freedom

Multiple correlations and regression analysis among different agricultural development parameters support the hypothesis hypotheses that some sort of relationships exists between the development factors and production components related to agriculture. A significant negative correlation between the urban facility and the men's involvement in farming indicates that if there is increased urban facilities with adequate non-farm employment options, men prefer to come out from the agricultural occupation. At the same time, the availability of non-farm employment with instant facilities cause the agricultural sector as ignored and excluded in the urban and peri-urban areas. And, the urban facilities, in turn, results in decreased agricultural production trend in particular.

On the other hand, commercial production, especially in urban agriculture, proceeds positively with the significant involvement of the urban farmers of the both sex if the urban facilities and opportunities are conducive to the farm people. An attempt was also made to analyze the possible relationship between the different parameters and components, but the regression was observed not significant (P-value = 0.688), with R-square (coefficient of determination) value 0.122 and standard error of estimate 6.487 (Appendix 9). Some agricultural production components are also observed as significantly correlated with the certain factors- such as landholding, irrigation and farmers' knowledge and skills. Table 15 presents some correlations between different agricultural factors and components as revealed from the present study.

Table 15. Correlation coefficient matrix of some agricultural factors and production components

Parameters	Land holding	Cereal production	Vegetable productivity	Irrigation problem
Land holding	1.000			
Cereal productivity	-0.423 **	1.00		
Vegetable productivity	-0.318 *	-0.289*	1.00	
Irrigation problem	0.109	-0.293*	0.231*	1.00

(Function: MULTIREG; Data case: 1 to 64)

* Significant at 0.05 level and 63 degrees of freedom
** Significant at 0.01 level and 63 degrees of freedom

Thus, likely as reported by Upreti *et al*. (2000-2001), the present finding supports the hypothesis that irrigation has substantial contribution to sustaining agricultural productivity, economy and food security under present Nepalese context. The analysis revealed the empirical relationship that the there is a significant negative correlation between the landholding and the productivity of cereals as well as vegetable crops. At the same time, the problem of irrigation seems to the most crucial bottleneck for the production and productivity if the crops. MULTIREG function was worked out to analyze the relationship between some agricultural factors and production components in the present study (Appendix 10). The regression (relationship) was observed significant (P-value = 0.000), with Intercept value 1.43454, R-square (coefficient of determination) value 0.546 and standard error of estimate 0.555.

A multiple linear regression model ($Y = ß_0 + ß_1X_1 + ß_2X_2$) was fitted describing the relationship of paddy yield (Y) with the irrigation problem index (X_1) and the number of animals domesticated (X_2), as follows.

$$\mathbf{Y = 49.99 - 4.62\ X_1 + 3.13\ X_2} \quad \text{……..(4)}$$

The regression was significant (p-value = 0.005) with the coefficient of determination (R^2-value) 0.158 (where adjusted R-Square and the standard error of estimates were 0.130 and 9.754). This indicates that 16% variation in paddy production

(yield) can be expected by the effect of irrigation problem and number of animals domesticated by the household (**Appendix 14**).

However, among the two regression coefficients ($ß_1$ and $ß_2$), $ß_2$ (the coefficient of X_2, the number of animals domesticated) was not significant (p = 0.376). This indicates that the linear relationship may not always exist between the yield and the number of animals domesticated. And, there might be some quadratic relationships between the number of animals domesticated and paddy yield.

Similarly, another multiple linear regression model ($Y = ß_0 + ß_1X_1 + ß_2X_2$) was also fitted describing the relationship of vegetable production (Y) with Location-inaccessibility index (X_1) and irrigation problem index (X_2), as follows.

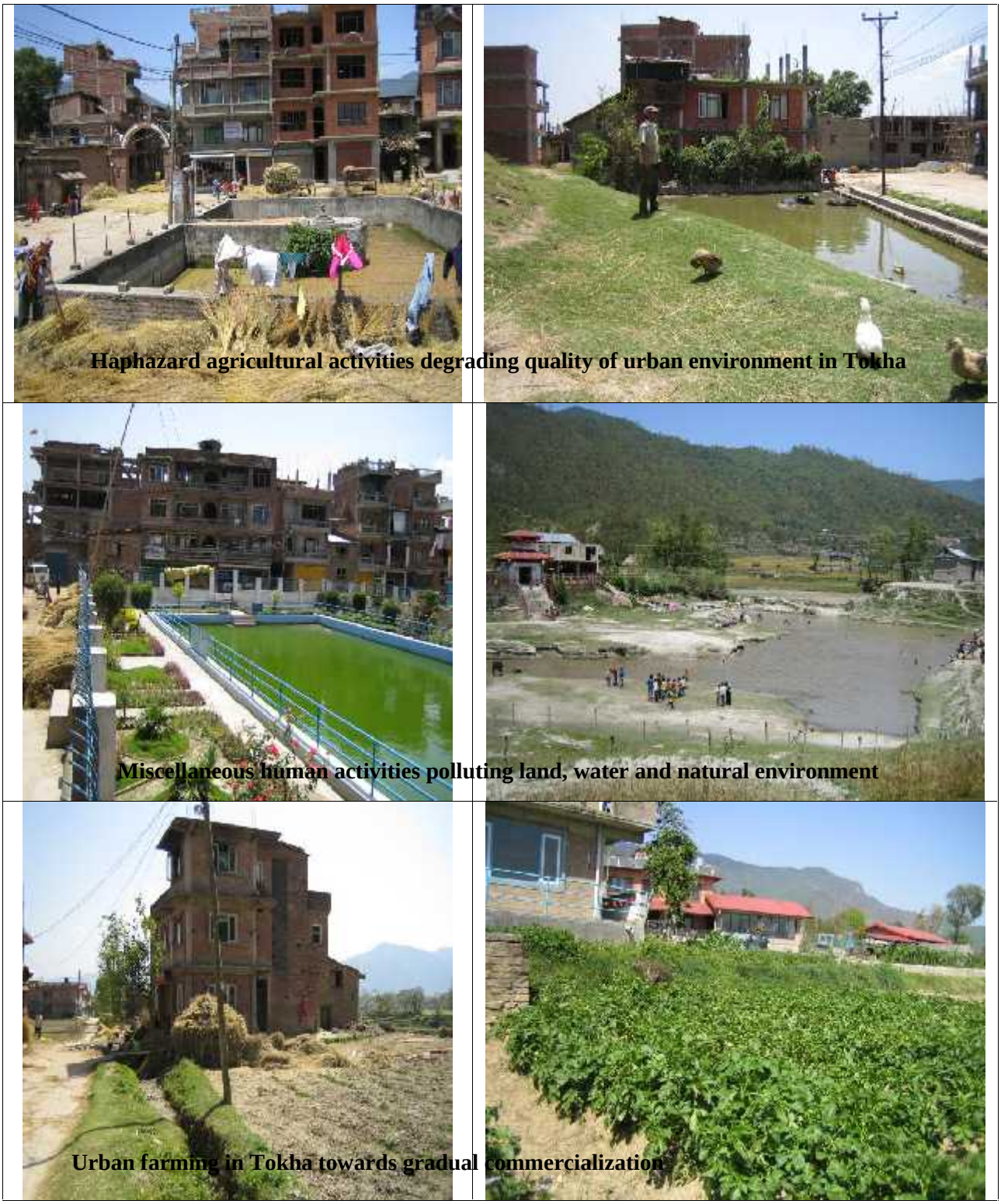
$$\mathbf{Y = 15.55 + 3.65\ X_1 - 1.45\ X_2} \quad \text{……..(5)}$$

The regression was significant (p-value = 0.000) with the coefficient of determination (R^2-value) 0.259 (where adjusted R-Square and the standard error of estimates were 0.235 and 6.392). This indicates that 26% variation in vegetable production can be expected by the difference in location (inaccessibly) and irrigation problem (**Appendix 15**). Likely with these regression models, Devkota *et al* (2003) had observed a significant relationship (multiple linear regression model) among the number of bee pollinator, colony performance index (CPI) of the pollinator bee colony and the seed yield of the broccoli crop.

4.13 Analysis of surrounding environment

The observation of the surrounding environment in Tokha seems to be pleasant as the location lies to nearby Shivapuri conservation forest (National park) area. However, the traditional agricultural activities in the Tokha area, at the same time, have been causing pollution and degradation of the surrounding environment (Figure 13, figure 2). Due to haphazard agricultural practices and unmanaged systems, the city is being reportedly polluted ad degraded. Figure 14 describes the relative environmental components causing crucial influences to surrounding environmental conditions.

Figure 13. Agricultural activities in Tokha affecting surrounding urban environment.

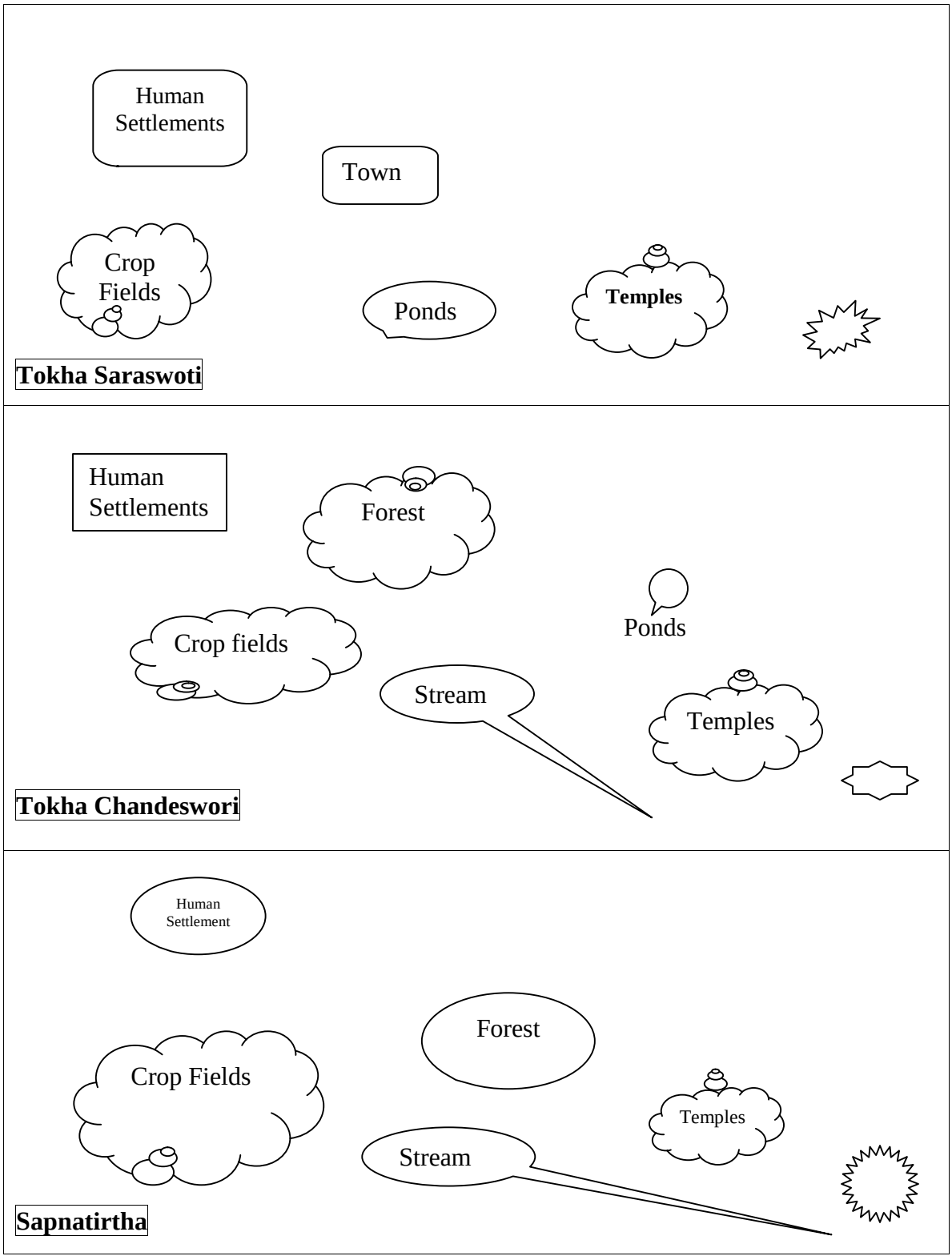


Haphazard agricultural activities degrading quality of urban environment in Tokha

Miscellaneous human activities polluting land, water and natural environment

Urban farming in Tokha towards gradual commercialization

Figure 14. Major environmental components causing crucial influences to surrounding environment in Tokha.



4.14 Agricultural problem intensity and development priority

Ranking of problems related to agriculture was carried out from farmers' perspective through 1-7 point based scoring, followed by marking with scoring index has been presented in Table 16. Inadequate irrigation facility was ranked as the most crucial problem related to agriculture in Tokha, followed by lack of agro-inputs, technical problems and decreased interest of people in agriculture. Unlikely to this Tulachan *et al*. (1983) presented the main constraint of foods and fodders for livestock and the problems of diseases and parasites.

The farmers' priority to different development functions in the study area as determined by means of priority scoring from the respondent farmers based on 1-6 point scoring and indexing with regard to the respective development function(s) shows that agriculture was the first priority of the respondents for the livelihood and development in the study area. Table 17 describes the farmers' priority to different development functions in the different studied pockets and Figure 15 depicts overall development priority by the farmers in the Tokha area.

Table 16. Intensity of problems in agriculture from farmer' perspectives in Tokha.

Problem Related to Agriculture	Average Marks (Based on 1-7 Scores Index)			Mean Marks	Problem Rank
	Saraswoti (P_1), n=20	Chandeswori (P_2), n=24	Sapnatirtha (P_3), n=20		
Irrigation problem	7.0	6.1	6.9	6.6	1
Marketing problem	2.3	3.7	3.5	3.2	5
Lack agriculture inputs	4.5	5.6	4.4	4.9	2
Technical problem	4.9	4.3	4.3	4.5	3
Decreased interest in agriculture	4.3	3.1	4.4	3.9	4
Financial problems	3.2	2.2	3.1	2.8	7
Inadequate road network	1.3	2.8	4.5	2.9	6
Total marks	**27.5**	**27.8**	**31.1**	**28.8**	
Agricultural Problem Index, API (%)	**56.1**	**56.7**	**63.5**	**58.8**	

The maximum score index (mark) indicates the highest severity of the problem.

Figure 15. Respondents' priority for different development functions in Tokha

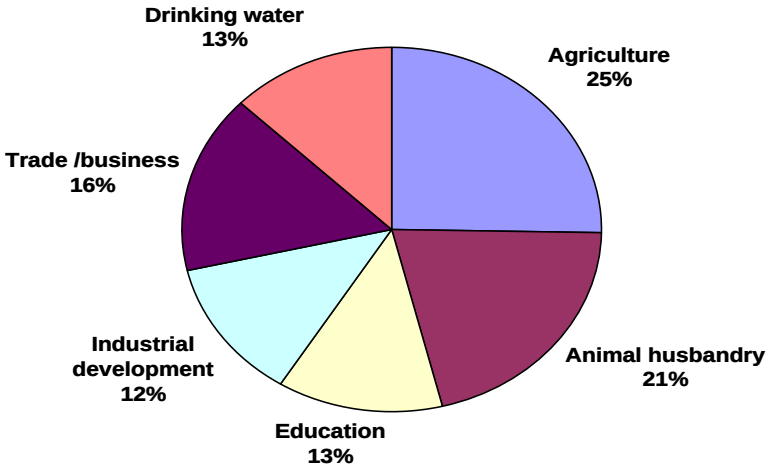


Table 17. Farmers' priority to different development functions in Tokha, 2006.

Development Functions	Average Marks (based on 1-6 scores)			Mean Score (Marks)
	Saraswoti (P_1), n=20	Chandeswori (P_2), n=24	Sapnatirtha (P_3), n=20	
Agriculture	4.7	5.6	5.1	5.1
Animal husbandry	3.4	4.7	4.3	4.2
Education	2.8	2.5	2.5	2.6
Industrial development	3.9	2.3	1.6	2.5
Trade /business	4.5	3.0	2.2	3.2
Drinking water	2.4	1.8	3.9	2.6
Road	1.4	2.9	4.9	3.1

The maximum score index (mark) indicates the highest priority of the function.

The correlation and regression analysis based on the observed data reveals significant relationships between some agricultural parameters (Table 18).

Table 18. Correlations between some observed agricultural parameters, Tokha, 2006.

	Owned land	Rented land	Family size	Farm occupation	Non-farm occupation	Priority to agriculture	Selling surplus
Owned land	1.00						
Rented land	-0.018	1.00					
Family size	0.002	0.106	1.00				
Farm occupation	-0.187	0.092	0.819**	1.00			
Non-farm occupation	-0.111	0.125	0.398 *	0.278 *	1.00		
Farmers' priority to agriculture	0.129	0.184	0.059	-0.088	0.004	1.00	
Selling over surplus	0.712**	-0.114	-0.035	-0.191	-0.021	0.059	1.00

(Function: MULTIREG; Data case: 1 to 64)

* Significant at 0.05 level and 63 degrees of freedom

** Significant at 0.01 level and 63 degrees of freedom

For instance, the correlation between the selling over surplus agricultural products and the landholding by the farmers was observed overwhelmingly significant. Likewise, farm occupation was observed as highly significantly correlated positively with the family size. It means to conclude that if the family size is large and there are no better non-farm employment opportunities, the people remain in the agriculture sector for their livelihood. At the same time, more interestingly it was observed that farm and non-farm occupations were also correlated in positive direction which indicates that non-farm occupations can be created only if there is developed condition of farming. In terms of the priority to agriculture sector, highest and positive r-value was observed with size of rented land and not with the owned land.

It lends to the conclusion that the people who have large sized owned land were not interested to engage in agriculture. Those who were still engaged in agriculture were the landless and the marginal farmers. The engagement was more compelling for subsistence rather than their interest. However, the priority of the respondents was not significantly correlated with none of the parameters observed in this case. It means that the factor which determines the priority to agriculture might be other than the above

factors under observation. Statistics shows the ANOVA for regression coefficients significant (P-value = 0.000), and hence, the observed relationships among the variables are statistically valid (Appendix 7). The present study shows the similar trends as revealed by the study report of Pyakuryal *et al.* (1977).

Chapter Five

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The present study has assessed and analyzed urban agriculture in Tokha, Kathmandu for its contribution to the economic well-being of urban and peri-urban farmers for their livelihood and poverty reduction. It examined the role of urban agriculture to generate employment, nutritional supply and socio-economic implications. This also analyzed the attitudes of the urban people with regard to increasing agricultural production, with identification of the organizations involved in supporting to agriculture development activities in the study area.

Tokha is an ancient city highly potential for the development of urban agriculture. Based on the observed scenario, market oriented agricultural production in Tokha at present includes vegetables, milk and poultry products. At the same time, there is an immense potentiality in Tokha for the development of beekeeping, mushroom farming, cereal production, goat and sheep farming, fruits and vegetable farming and floricultural enterprises. However, there are some problems in order to grasp with such potentialities. The most critical problems of agricultural development include the inadequate irrigation facilities, less developed road network and infrastructural facilities including storage structures and inadequate technical support to the farmers. The study indicates that all the farmers in Tokha are mainly dependent on agrochemicals (chemical fertilizers, and pesticides) for crop production and concept of organic farming has not been introduced. But, with the increased standards of living and awareness to health and environmental concerns, questions are being raised regarding the quality of agricultural products. In this regard, agriculture in Tokha need to avoid crop contamination, environmental pollution by farming practices in order to attract urban consumers with better health and environment. At the same time, national policy makers need to develop a sustainable food growing policy, encompassing financial, technical and other supports, including research, for promoting urban agriculture, specially for reducing urban poverty through urban food security and employment generation. The strategies are needed to further promote private initiatives in urban farming. Measures such as irrigation, technology extension, cheap credit for agriculture, promotion of foreign investment in the

processing of local agricultural production and reduction of production risks can support the process of stabilizing private urban farming. More specifically, based on the present study, the following recommendations are made to promote urban agriculture in Tokha for enhancing employment and urban food security.

5.2 Recommendations for Further Studies

Based on the existing scenario, one of the most frequently practiced agricultural enterprises in Tokha is the growing agronomic crops, specially paddy, wheat, potato and maize, mainly in a subsistence manner. More than 80% farm households have home garden, but only for family consumption of fruits and vegetables. In spite of its higher potentiality, very few farmers in Tokha produce fruits and vegetable for market purpose. Livestock, mainly buffalo, dairy cattle, goat farming and poultry production are highly potential in the area. Integrated development of crops, livestock and poultry, market oriented organic vegetable production, fruit growing, sustainable community forest management and beekeeping seems to be highly potential in Tokha for maintaining agricultural productivity, sustainability and conservation of biodiversity, enhancing urban food security and employment. In fact, urban agriculture can be one of the most appropriate means to alleviate poverty. In this context, the following points are recommended for further research and development studies on urban agriculture in Tokha area.

- Irrigation is the major problem of agricultural production in Tokha as reported by the farmers. In the Chandeshwori pocket, although there are irrigation canals including ***Rajkulo***, irrigation water is inadequate. In Tokha Saraswoti and Sapnatirtha, the problem of irrigation is more critical. So, studies are needed to promote irrigation facilities through utilizing surface and underground water sources.
- Beekeeping is no more practiced in Tokha area. But, beekeeping promotion is also potential in the area if integrated with horticulture, seed production and forest development. As Tokha is nearby Shivapuri forest, wild beefloral resources are also adequately available around the location. Further studies regarding apicultural promotion are imperative in the area.

- Organic farming, including market oriented organic vegetable farming should be promoted in Tokha to attract the urban consumers and the agro-tourists. Farmers need to be trained in organic practices, such as composting, vermi-composting, green manuring, etc.
- Fruit farming practice is very low in Tokha. Fruits such as lemon, pear, peach, plum, straw berry, etc. can be kept under in-depth research.
- Few farmers practice mushroom farming and they are interested in mushroom cultivation commercially, but they reported lacking in technical know how on it. So that DADO/ASC and other concerned institutions should conduct studies, training and extension programs on mushroom farming in Tokha.
- Agro-processing and storage facilities are lacking in Tokha. Considering farmers' needs and possibilities, studies are needed towards establishment of agro-product processing and storage structures.
- Agricultural extension service seems to be no more effective in Tokha. DADO and DLSO should functionalize Agricultural Service Center and Livestock Service Center in Tokha with appropriate group and cooperative mobilization, co-ordination with other institutions involved in agriculture and financial supports. Access to improved agricultural inputs, such as quality seed, should be improved as needed to the local farmers.
- Local Governmental Institutions (VDCs/ DDC) should also implement policies and programs for promoting sustainable urban farming towards market oriented organic production systems in coordination with concerned institutions. Further policy research and developmental studies are requested to alleviate poverty through the development of commercialized urban agriculture in Tokha

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Appendix 1. Questionnaire used for the survey in Tokha

Name of HH Head: …… ….. ….Male/Female Total family members: ……..
Address: VDC/Na.Pa.: …… Ward No.: …… Tole: ……. …….. ….

SA = Single Answer	**SAS** = Single Answer with Sub-answer
MA = Multiple Answer	**MAS** = Multiple Answer with Sub-answer

1. Family statistics:

1.1 Employment situation (Number)						1.2 Cultivated land							1.3 Livestock and poultry			
Sector	M	F	Total	**Major**	**Minor**	**Type**	**Area (Ropany)** Own	L.Lords	Major crops grown	Annual producti	Purpose Cons	Sale	Type	No.	Purpose Cons	Sale
						Irrigated							Bufa			
Agric						Khet							cattle			
Labor						Pakho							Goat			
Service						**Unirri**							Poulti			
Trade/ business						Khet							…….			
Teaching						Pakho							……			
……						**Total**							.....			

2. What is the agric. Occupation to your family? (SA)
   - 0 (a) Means of full employment
   - 0 (b) Means of partial employment
   - 0 (c) Source of additional incomes
   - 0(d) Hobby or recreation
   - 0(e) Means of proper use of spare time

3. Prioritize following works (1-6) for the integrated development of this location (MAS).
   - (…) (a) Agriculture (Fruits/ vegetables/ Cereals/ Floriculture/ Beekeeping/ Mushroom)
   - (…) (b) Livestock (Cattle/buffalo/ Poultry/ Duck/ Goat/ Other (specify) …….
   - (…) (c) Industry (if possible, specify) ……. ……. ……
   - (…) (d) Trade/ business (if possible, specify) ……. …… …...
   - (…) (e) Educational institutions (if possible, specify) ……. ……. ....
   - (…) (f) Others (specify) ……. ……. ……. …….

4. Do you have knowledge on nutrition ? 0 (a) Yes. 0 (a) No.
5. How does the nutritional needs of your family fulfill? (**MAS**)
   - 0 (a) Market purchase: 0 1. Sometimes 0 2. Often 0 3. Always
   - 0 (b) Purchase from farmers: 0 1. Sometimes 0 2. Often 0 3. Always
   - 0 (c) Consuming own product: 0 1. Sometimes 0 2. Often 0 3. Always
   - 0 (d) Selling over surplus: 0 1. Sometimes 0 2. Often 0 3. Always
6. Do you practice use/re-use of HH waste water? 0 (a) Yes. 0 (a) No.
7. Where does the drains from toilet, sheds, pen, etc go ?
   - 0 (a) Street/ Road
   - 0 (b) Compost pit
   - 0 (c) Bio-gas plant
   - 0 (d) Stream
   - 0 (e) Other (specify) …… ……
8. Do you use chemical fertilizer ? 0 (a) Yes. 0 (a) No.
   If yes, for which crop? …….
   From where do you brought? …….....

9. Do you use following materials in farming ? (Tick whatever is applicable).

0 (a) FYM 0 (b) Compost

0 (c) Green manure ..... 0 (d) Vermi-compost

0 (e) Veterinary medicines ..... 0 (f) Micronutrient fertilizers .....

0 (g) Lime

10. What do you do when pests/ diseases attack to your crop ? (**MA**)

0 (a) Doing nothing 0 (b) Using bio-pesticides .....

0 (c) Botanicals 0 (d) Chemical pesticides .....

0 (e) Adopting IPM practices 0(f) Traditional methods (if Yes, specify)……

11. Have you (or anyone of your family) participated in any training, study, visit, etc, related to improved/modern agricultural technology? 0 (a) Yes. 0 (a) No.

If yes, specify. …….. …….. ……

12. Are there any institutions/organizations supporting to your farming ?

0 (a) Yes. 0 (a) No.

If yes, fill the following:

Type of organization	Name(s) of the organization /institution(s)	Type of assistance
(a) Governmental		
(b) Local governmental		
(c) NGOs		
(d) Private firms		
(e) Academic institutions		

13. Have you borrowed agricultural loan? 0 (a) Yes. 0 (a) No.

If yes, for what purpose? …… …….. ..

From where (source): …… ……. How much (Rs): …….

14. Please assign priority (1-7) to the following agriculture related problems in your area.

(….) a. Irrigation problem (….) b. Marketing problem

(….) c. Lack of agricultural inputs (….) d. Financial /economic problem

(….) e. Technical problem (….) f. Decreased interests in agriculture

(….) g. Other (specify): …… …

15. As compared to the past, what is the existing trend in agricultural productivity?

0 (a) Decreasing productivity

0 (b) Constant productivity

0 (c) Increasing productivity

Specify the cause/reason: …… …

16. Have you any suggestions for agricultural development (If yes, specify wording).

……

……

……

…….

Thank You

Appendix 2. Observation Sheet

Locality Name:…….. …… Tole: …… Ward No.:…….. VDC/Na. Pa.:…….
Community /ethnic group: ……. Settlement Type: Urban / Rural /Dispersed/ Agglomerated

---

A. Housing Types:

- Construction materials: ……
- Windows :……..
- Doors : …….
- Roof type: RCC/ RBC/, Zinc Sheet, Khar/Paral/Seula, Others (specify):……..

B. Surrounding Environment:

1. Field
2. Forest
3. Human settlement
4. Ponds
5. Streams/ rivers
6. Others (specify): ……

C. Irrigation Pattern:

(1) Canal
(2) Rajkulo
(3) Traditional system
(4) Tubewell
(5) River /stream (specify) …….
(6) Others (specify) ……..

D. Market Facility:

Are there shops nearby, related to agriculture? (a) Yes (b) No

If yes, specify the type and number of shops dealing with farm products.

Type	number
1 …….	…..
2 …….	…..

E. Access to agricultural extension/ service:

1. Agric. Service Center nearby (yes/no):……..
2. Livestock Service Center nearby (yes/no):……..
3. Agro-vet shop nearby (Yes/no): ……
4. Access to road (Yes/no): ……
5. Agro product storage facility (Yes/no): …….
6. Availability of financial (bank, etc.) service (Yes/no): …….

F. Agricultural Integration:

1. Agronomic crops (Yes/no): …….
2. Poultry farming (Yes/no): …….
3. Goat/ Sheep farming (Yes/no): …….
4. Livestock (cattle/ buffalo) farming (Yes/no): ……
5. Home/Kitchen gardening (Yes/no): …….
6. Commercial fruit orchard (Yes/no): …….
7. Commercial vegetable farming (Yes/no): …….
8. Floriculture/ Flower Nursery (Yes/no): …….
9. Beekeeping (Yes/no): …….
10. Mushroom farming (Yes/no): …….

G. Resource Recycling:

1. Biogas plant (Yes/no): ……
2. Composting toilet (Yes/no): ……
3. Vermi-composting (Yes/no): ……
4. In-situ manuring (Yes/no): ……
5. Household waste water utilization (Yes/no): …… If yes, describe the purpose and type of utilization of HH waste water: …… ……. ……. ……

-XXX-

Appendix 3. Inquiry Checklist used for key informant/focus group discussion

Number of person: ……	Sex: Male ……., Female…….
Type: ……	Caste/ Ethnic group: …….
Place: ……..	Date: ……..

1. Production trend in agriculture:

2. Crop production pattern (types):

3. Market demand:

4. Agricultural infrastructure:

5. Problems related to agriculture and livelihood:

6. Agricultural potentialities:

7. Transportation:

8. Role of institutions:
   - Government (central):
   - Local government:
   - Cooperatives:
   - NGOs:
   - Private institutions:

9. Investment pattern:

10. Partnership/ Collaborative (%):

Thank you!

Appendix 4. Chi square analysis of variations in employment pattern

Calculation of Chi Square for Employment Pattern

Calculation of expected frequencies

	Observed frequencies				Expected Frequencies			
Sector	Saraswoti	Chandeshwori	Sapnatirtha	RT	Saraswoti	Chandeshwori	Sapnatirtha	RT
Agriculture	97	84	67	248	99.4884	83.628	64.884	248
Service	12	4	5	21	8.42442	7.0814	5.4942	21
Trade/Business	7	9	1	17	6.81977	5.7326	4.4477	17
Waged labour	16	12	15	43	17.25	14.5	11.25	43
Foreign employment	6	7	2	15	6.01744	5.0581	3.9244	15
CT	138	116	90	344	138	116	90	344

Calculation of Chi square Value

	(O-E)				$(O-E)^2/E$			
	Saraswoti	Chandeshwori	Sapnatirtha		Saraswoti	Chandeshwori	Sapnatirtha	Total
Agriculture	-2.48837	0.372093	2.116279		0.06224	0.0017	0.069	0.132919
Service	3.575581	-3.0814	-0.49419		1.51759	1.3408	0.0445	2.902873
Trade/Business	0.180233	3.267442	-3.44767		0.00476	1.8624	2.6725	4.539649
Waged labour	-1.25	-2.5	3.75		0.09058	0.431	1.25	1.771614
Foreign employment	-0.01744	1.94186	-1.92442		5.1E-05	0.7455	0.9437	1.689224
CT			**Observed Chi Square value**					**11.03628 ns**

Df = (c-1)(r-1)		8
Table value of Chi square	1% LS	20.09
	5% LS	15.51

*** Significant at 5% level**
**** Significant at 1% level**
ns- Not significant

Appendix 5. Analysis of Variance (ANOVA) for different agricultural variables.

Function: ANOVA-2
Data case 1 to 64
Two-way Analysis of Variance over: Variable 1 (Location) with values from 1 to 3 and variable 2 (Households) with values from 1 to 24.

The following missing values are estimated:

For var 1 = 1 and var 2 = 21,	Estimated value=	9.899
For var 1 = 1 and var 2 = 22,	Estimated value=	11.899
For var 1 = 1 and var 2 = 23,	Estimated value=	11.899
For var 1 = 1 and var 2 = 24,	Estimated value=	6.899
For var 1 = 3 and var 2 = 21,	Estimated value=	7.649
For var 1 = 3 and var 2 = 22,	Estimated value=	9.649
For var 1 = 3 and var 2 = 23,	Estimated value=	9.649
For var 1 = 3 and var 2 = 24,	Estimated value=	4.649

Variable 1: Landholding
(a) Owned land:

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	520.79	260.394	4.40	0.0191
Households	23	1473.43	64.062	1.08	0.4050
Error	38	2250.11	59.213		
Total	63	4244.33			

Grand Mean= 6.167; Grand Sum = 444.021; Total Count= 72; C.V. = 124.78%.

(b) Rented Land:

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	13.00	6.501	1.58	0.2195
Households	23	71.24	3.097	0.75	0.7629
Error	38	156.50	4.118		
Total	63	240.74			

Grand Mean = 1.083; Grand Sum = 78.006; Total Count = 72; C.V.= 187.31%

(c) Total Landholding:

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	333.61	166.803	2.94	0.0649
Households	23	1396.26	60.707	1.07	0.4159
Error	38	2154.78	56.705		
Total	63	3884.64			

Grand Mean= 7.167; Grand Sum= 516.021; Total Count= 72;
Coefficient of Variation= 105.07%.

Variable 3: Family size

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	111.15	55.575	5.62	0.0073
Households	23	371.97	16.173	1.63	0.0877
Error	38	376.03	9.896		
Total	63	859.16			

Grand Mean= 7.892 Grand Sum= 568.192 Total Count= 72
Coefficient of Variation= 39.86%

Variable 4: Female in agriculture

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	3.88	1.940	1.45	0.2468
Households	23	28.58	1.243	0.93	0.5639
Error	38	50.77	1.336		
Total	63	83.23			

Grand Mean= 2.083; Grand Sum= 149.999; Total Count= 72; C.V. = 55.48%.

Variable 5: Male in agriculture

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	14.44	7.220	5.64	0.0072
Households	23	31.31	1.362	1.06	0.4225
Error	38	48.63	1.280		
Total	63	94.39			

Grand Mean= 1.817 Grand Sum= 130.797 Total Count= 72
Coefficient of Variation= 62.27%

Variable 9: Paddy production

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	1169.98	584.992	5.88	0.0060
Households	23	2813.91	122.344	1.23	0.2794
Error	38	3779.57	99.462		
Total	63	7763.46			

Grand Mean= 19.584; Grand Sum= 1410.026; Total Count= 72;
Coefficient of Variation= 50.93%

Variable 10: Wheat production

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	156.98	78.490	6.05	0.0052
Households	23	323.95	14.085	1.09	0.4018
Error	38	493.17	12.978		
Total	63	974.09			

Grand Mean= 5.792 Grand Sum= 417.010 Total Count= 72
Coefficient of Variation= 62.20%

Variable 11: Maize production (Muri)

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	476.17	238.084	1.42	0.2542
Households	23	3312.33	144.014	0.86	0.6442
Error	38	6370.40	167.642		
Total	63	10158.90			

Grand Mean= 1.742 Grand Sum= 125.442 Total Count= 72
Coefficient of Variation= 743.16%

Variable 12: Potato production (Quintals)

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	349.48	174.739	10.99	0.0002
Households	23	895.32	38.927	2.45	0.0070
Error	38	604.24	15.901		
Total	63	1849.03			

Grand Mean= 3.933 Grand Sum= 283.211 Total Count= 72
Coefficient of Variation= 101.38%

Variable 13: Buffalo (number)

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	2.92	1.460	1.76	0.1862
Households	23	32.58	1.416	1.71	0.0707
Error	38	31.57	0.831		
Total	63	67.07			

Grand Mean= 0.633; Grand Sum= 45.599 Total Count= 72; C.V. = 143.91%.

Variable 14: Cattle (number)

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	2.28	1.140	1.08	0.3497
Households	23	22.82	0.992	0.94	0.5525
Error	38	40.10	1.055		
Total	63	65.20			

Grand Mean= 0.775 Grand Sum= 55.801 Total Count= 72
Coefficient of Variation= 132.55%

Variable 9: Goat

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	0.64	0.320	0.10	0.9015
Households	23	101.09	4.395	1.43	0.1607
Error	38	116.80	3.074		
Total	63	218.53			

Grand Mean= 1.717 Grand Sum= 123.595 Total Count= 72
Coefficient of Variation= 102.13%

Variable 10: sheep

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	0.52	0.260	1.58	0.2183
Households	23	11.52	0.501	3.05	0.0011
Error	38	6.23	0.164		
Total	63	18.27			

Grand Mean= 0.117 Grand Sum= 8.399 Total Count= 72
Coefficient of Variation= 347.20%

Variable 11: Poultry

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Treatment	2	792.15	396.074	0.27	0.7632
Replication	23	30471.33	1324.840	0.91	0.5863
Error	38	55312.27	1455.586		
Total	63	86575.75			

Grand Mean= 9.226; Grand Sum= 664.298; Total Count= 72;
Coefficient of Variation= 413.51%

Variable 12: Duck

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	6.76	3.379	0.97	0.3882
Households	23	249.86	10.863	3.12	0.0009
Error	38	132.37	3.483		
Total	63	388.98			

Grand Mean = 1.133 Grand Sum= 81.595 Total Count= 72
Coefficient of Variation= 164.69%

Variable 15: Households obtained agricultural training

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	0.48	0.240	1.63	0.2097
Households	23	7.60	0.330	2.24	0.0133
Error	38	5.60	0.147		
Total	63	13.68			

Grand Mean = 0.233 Grand Sum = 16.801, Total Count= 72, C.V. = 164.51%

Variable 17: Market facility

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	14.56	7.280	230.53	0.0000
Households	23	0.70	0.030	0.96	0.5266
Error	38	1.20	0.032		
Total	63	16.46			

Grand Mean= 0.350 Grand Sum= 25.200 Total Count= 72
Coefficient of Variation= 50.77%

Variable 18: Access to Agricultural extension service

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	8.44	4.220	54.05	0.0000
Households	23	1.76	0.076	0.98	0.5099
Error	38	2.97	0.078		
Total	63	13.16			

Grand Mean= 0.258 Grand Sum= 18.599 Total Count= 72
Coefficient of Variation= 108.16%

Variable 19: Bio-gas use

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	0.12	0.060	1.20	0.3124
Households	23	3.50	0.152	3.04	0.0012
Error	38	1.90	0.050		
Total	63	5.52			

Grand Mean= 0.083 Grand Sum= 5.999 Total Count= 72
Coefficient of Variation= 268.36%

Variable 21: Resource recycling index (RRI)

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	0.16	0.078	0.61	0.5502
Households	23	4.10	0.178	1.40	0.1774
Error	38	4.86	0.128		
Total	63	9.11			

Grand Mean= 0.230 Grand Sum= 16.559 Total Count= 72
Coefficient of Variation= 155.45%

Variable 22: Vegetable production (Quintals)

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	89.37	44.684	3.59	0.0372
Households	23	519.36	22.581	1.82	0.0502
Error	38	472.36	12.430		
Total	63	1081.08			

Grand Mean= 1.750 Grand Sum= 126.004 Total Count= 72
Coefficient of Variation= 201.46%

Appendix 6. Chi square analysis of farmers' responses to agriculture as employment

Calculation of expected frequencies								
Employment type	Observed frequencies (O)				Expected frequencies (E)			
	Respondent %				**Respondent %**			
	Saraswoti	Chandeswori	Sapnatirtha	**RT**	Saraswoti	Chandeswori	Sapnatirtha	**RT**
Full employment	35	54.17	55	144.17	48.05667	48.05667	48.057	144.17
Partial employment	50	41.66	45	136.66	45.55333	45.55333	45.553	136.66
Additional income	10	4.17	0	14.17	4.723333	4.723333	4.7233	14.17
Using spare time	5	0	0	5	1.666667	1.666667	1.6667	5
CT	100	100	100	300	100	100	100	300
Calculation of χ^2 Value								
	O-E				$\chi^2 = \sum (O-E)^2/E$			
	Saraswoti	Chandeswori	Sapnatirtha		Saraswoti	Chandeswori	Sapnatirtha	Total
Full employment	-13.0567	6.113333	6.943333		3.547407	0.777683	1.0032	5.3283
Partial employment	4.446667	-3.89333	-0.55333		0.434059	0.332754	0.0067	0.7735
Additional income	5.276667	-0.55333	-4.72333		5.894822	0.064822	4.7233	10.683
Using spare time	3.333333	-1.66667	-1.66667		6.666667	1.666667	1.6667	10
					16.542955	2.841926	7.3999	**26.785**
Observed Chi Square Value (χ^2) = 26.785 **								
Degrees of freedom = (c-1)(r-1) = 6								
Table value of χ^2 for 6 df and 0.01 LS = 16.81								

Appendix 7. Computer output on relations between agricultural parameters, Tokha area, 2006.

Data file : MSTATC/ TOKHA
Title : Correlation
Function : MULTIREG, Data case no. 1 to 64
(64 Cases read 0 Missing cases discarded)

Variables:
1. Owned land
2. Rented land
3. Family size
4. Farm occupation
5. Non-farm occupation
6. Farmers' priority to agriculture
7. Selling over surplus product

Correlation Matrix

	1	2	3	4	5	6	7
1	1.000						
2	-0.018	1.000					
3	0.002	0.106	1.000				
4	-0.187	0.092	0.819	1.000			
5	-0.111	0.125	0.398	0.278	1.000		
6	0.129	0.184	0.059	-0.088	0.004	1.000	
7	0.712	-0.114	-0.035	-0.191	-0.021	0.059	1.000

Determinant of matrix = 0.211061

ANALYSIS OF VARIANCE TABLE

Source	Sum of Squares	df	Mean Square	F	Signif
Regression	13.725621	6	2.28760	10.62	0.000
Residual	12.274379	57	0.21534		
Total	26.000000	63			

Appendix 8. Analysis of variance (ANOVA) for some variables related to agricultural production and commercialization trends.

Function: ANOVA-2
Software: MSTATC
Data case 1 to 64
Two-way Analysis of Variance over: Variable 1 (Location) with values from 1 to 3 and variable 2 (Households) with values from 1 to 24.

Variable 16: Production trend in agriculture

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	0.76	0.380	0.68	0.5149
Households	23	11.81	0.513	0.91	0.5831
Error	38	21.37	0.562		
Total	63	33.93			

Grand Mean= 0.425, Grand Sum= 30.598 Total Count= 72
Coefficient of Variation= 176.45%

Variable 20: Vegetable commercialization

A N A L Y S I S O F V A R I A N C E T A B L E

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Prob
Location	2	0.28	0.140	0.69	0.5102
Households	23	6.36	0.276	1.35	0.2003
Error	38	7.77	0.204		
Total	63	14.40			

Grand Mean= 0.275 Grand Sum= 19.799 Total Count= 72
Coefficient of Variation= 164.41%

Appendix 9. Relationship between some agricultural development parameters.

Data file : CORRELATION
Title : Agricultural development parameters
Function : MULTIREG (software: MSTATC)
Data case no. 1 to 64

Variables:
2. Women in farming
3. Men in farming
4. Agricultural production trend
5. Urban facility
6. Commercial production

	Minimum	Maximum	Uncorrected Sum	Mean	Sum of Squares
2	1.00	6.00	133.00	2.078	355.00
3	0.00	5.00	115.00	1.797	297.00
4	-1.00	1.00	-39.00	-0.609	57.00
5	1.00	3.00	127.00	1.984	293.00
6	0.00	1.00	16.00	0.250	16.00
1	1.00	3.00	128.00	2.000	296.00

64 Cases read 0 Missing cases discarded
Determinant of matrix = 0.393998

Coefficient Correlation Matrix:

	2	3	4	5	6
2	1.000				
3	-0.703	1.000			
4	-0.087	0.003	1.000		
5	0.027	-0.242	0.033	1.000	
6	0.334	-0.393	0.045	-0.009	1.000

ANALYSIS OF VARIANCE TABLE

	Sum of Squares	df	Mean Square	F	Signif
Regression	39.208694	5	7.84174	574.77	0.000
Residual	0.791306	58	0.01364		
Total	40.000000	63			

Appendix 10. Correlation between agricultural factors and components (Computer output)

Function : MULTIREG
Data case no. 1 to 64

Variables:
1. Landholding
2. Cereal production
3. Vegetable production
4. Irrigation problem

	Minimum	Maximum	Uncorrected Sum	Mean	Sum of Squares
1	4.00	60.00	514.50	8.039	7778.25
2	4.00	60.00	873.00	13.641	20469.00
3	0.00	40.00	393.00	6.141	5757.00
4	3.00	7.00	423.00	6.609	2843.00

64 Cases read 0 Missing cases discarded
Determinant of matrix = 0.433423

Coefficient Correlation Matrix:

	1	2	3	4
1	1.000			
2	-0.423	1.000		
3	-0.318	-0.289	1.000	
4	0.109	-0.293	0.231	1.000

ANALYSIS OF VARIANCE TABLE

	Sum of Squares	df	Mean Square	F	Signif
Regression	21.824112	4	5.45603	17.71	0.000
Residual	18.175888	59	0.30807		
Total	40.000000	63			

Appendix 11. Some Feature of Different Categories of Urban Agriculture.

Feature	Category of Urban Agriculture		
	On-plot	Off-plot (both legal and illegal)	Periurban
Location	On property in both high and low-density areas	Public open spaces, utility service area all over the city and on allotments.	Outside the city boundary in rural areas.
Consumption mode	Mainly subsistence, more commercial in low-density areas.	Mainly subsistence, slightly more marketed output than on-plot production.	Subsistence in smallholder sector but marketing on the increase
Crops produced	Maize, vegetables and fruit	Maize, sweet potato, fruits and vegetables.	Maize, vegetables, fruits and other horticultural crops.
Plot size	Up to 50 m^2 and can be as high as 1 acre in low-density area.	Average 200 m2 up to 2 acres per household cultivator.	3 acres for smallholders and 5 ha or more for large-scale producers.
Livestock	Negligible	Negligible	Poultry, pork, milk, beef, etc.
Household involved	80% of property in summer and 60% in winter; 70% property owners and 30% lodgers.	At most 25% of the city households, property owner's dominance.	Those with land-access right.
Fertilizer use	Low level	Low level	High level
Involvement of the poor	Very low	Low	High potential
Status of research	Fair in high density areas, very little in low-density areas.	Fair in all areas.	Not well studied from an urban perspective.

Source: Mbiba, B. (2000).

Appendix 12. Potential Environmental Implication of Urban Agriculture.

Categories of Environmental Impact	Example of Environmental Effects	Study Results	Implication of Effects
Change in the hydrological regime of the area	⁾ More run-off and land surface flooding ⁾ Less infiltration	⁾ Run-off increase by 35% on average ⁾ Infiltration reduced 28.5% on average	⁾ Flooding damage to property, transport routes and infrastructure ⁾ Cost of maintenance
Soil erosion	⁾ Lowering of the surface ⁾ Deposition of eroded sediments	⁾ Soil loss on 40% of cultivated sites exceeds tolerable levels ⁾ High levels of deposition of eroded sediments	⁾ Logging of city drains, nuisance to transport ⁾ Health problems ⁾ Increased costs of maintenance
Ecological changes	⁾ Changes in species types ⁾ Reduced biodiversity ⁾ Loss of soil cover, loss of tree cover	⁾ High ⁾ High ⁾ High	⁾ Loss of species habitat ⁾ Loss of biodiversity ⁾ Soil erosion
Chemical pollution	⁾ Lead uptake of crops from exhaust fumes ⁾ Vegetation toxicity from industrial effluents ⁾ Reduction in water quality	⁾ High ⁾ Probable ⁾ probable	⁾ Algal blooms ⁾ Potential health hazards to consumers ⁾ Threats to wildlife ⁾ Increased costs of water purification
Landscape and aesthetics	⁾ Loss of scenery and diversity of environment.	⁾ Indeterminate	⁾ Loss of recreational spaces ⁾ Increased costs to access alternatives
Diseases	⁾ Vector-borne diseases	⁾ Indeterminate	⁾ Potential for diseases related to water, refuse, manure and animals. ⁾ Costs of monitoring, control and treatment.

Source: Bowyer-Bower and Drakakis-Smith, 1996 (Adapted from**:** Mbiba, B., 2000).

Appendix 13. Updated Information on Agriculture Development in Kathmandu District.

1. General Information:

Total Cultivable Land:	19205 Hectare
Irrigated Land:	13336 Hectare
District Agriculture Development Office:	1
Agriculture Service Centers:	10
District Livestock Service Office:	1
Agriculture Service Centers:	10
Total co-operatives in the district:	750
Milk production cooperatives	38
Total cooperative members:	44400

2. Livestock and Poultry Information:

Livestock and Birds (Number)		Animal Products	
Cattle	38503	Milk production (MT)	15504
Buffalo	24373	Meat production (MT)	11358
Goat	47366	Egg production (NRs Thousands)	611168
Sheep	6632	Wool production (Kg)	4486
Pigs	7312		
Poultry	1586325		
Others	5170		

3. Crop Production Information:

S.N.	Major Crops	Cultivated Area (Hectare)	Production (M.T.)
1	Paddy	2180	128
2	Maize	2130	2788
3	Wheat	2160	5912
4	Oilseeds	1462	10932
5	Legumes (Pulse crops)	235	138

Source: District Development Committee, Kathmandu (2005).

Appendix 14. Regression of Irrigation Problem Index, Number of Animals Domesticated and Paddy Production.

Data file : D/MSTATC/REGRESSION
Title : Agricultural parameter
Function : MULTIREG
Data case no. 1 to 64

Variables:

1. Irrigation Problem index
2. Animals domesticated (Number)
3. Paddy Yield (dependent variable)

Variable	Minimum	Maximum	Sum	Mean	Uncorrected Sum of Squares
1	3.00	7.00	423.00	6.609	2843.00
2	0.00	204.00	849.00	13.266	88437.00
3	6.00	60.00	1273.00	19.891	32213.00

64 Cases read 0 Missing cases discarded
Determinant of matrix = 0.999875

Regression Analysis:

Variable Number	Regression Coefficient	Standard Error	Std. Partial Regr. Coeff.	Std. Err. of Partial Coef	Student T Value	Prob.
1	-4.6167e+000	1.4193e+000	-3.8219e-001	1.1750e-001	-3.253	0.002
2	3.1296e-002	3.5114e-002	1.0472e-001	1.1750e-001	0.891	0.376

Intercept	=	49.988822
Coefficient of Determination (R-Square)	=	0.158
Adjusted R-Square	=	0.130
Multiple R	=	0.397
Standard Err of Est.	=	9.754

ANALYSIS OF VARIANCE TABLE

Source	Sum of Squares	df	Mean Square	F	Signif
Regression	1088.499893	2	544.24995	5.72	0.005
Residual	5803.734482	61	95.14319		
Total	6892.234375	63			

Appendix 15. Regression of Location (inaccessibility index), Irrigation Problem Index and Vegetable Production.

Data file : D/MSTATC/REGRESSION
Title : Agricultural dev parameter
Function : MULTIREG
Data case no. 1 to 64

Variables:

1. Location (Inaccessibility Index)
2. Irrigation Problem Index
3. Vegetable production (Dependent Variable)

Variable	Minimum	Maximum	Sum	Mean	Uncorrected Sum of Squares
1	-21.00	42.30	0.00	0.000	5803.73
2	3.00	7.00	423.00	6.609	2843.00
3	0.00	40.00	383.00	5.984	5657.00

64 Cases read 0 Missing cases discarded
Determinant of matrix = 1.000000

Regression Analysis:

Variable Number	Regression Coefficient	Standard Error	Std. Partial Regr. Coeff.	Std. Err. of Partial Coef	Student T Value	Prob.
1	3.6507e-001	8.3907e-002	4.7944e-001	1.1019e-001	4.351	0.000
2	-1.4479e+000	9.3008e-001	-1.7154e-001	1.1019e-001	-1.557	0.125

Intercept	=	15.554085
Coefficient of Determination (R-Square)	=	0.259
Adjusted R-Square	=	0.235
Multiple R	=	0.509
Standard Err of Est.	=	6.392

ANALYSIS OF VARIANCE TABLE

Source	Sum of Squares	df	Mean Square	F	Signif
Regression	872.514869	2	436.25743	10.68	0.000
Residual	2492.469506	61	40.86016		
Total	3364.984375	63			

Appendix 16. Statistical tools used in the study

(a) Two way analysis of variance:

Source of Variation	df	SS	MS	F-value
Location (main effect- row)	r-1	$SSR = \frac{1}{cn} \sum_{i=1}^{r} Ri^2 - \frac{G^2}{rcn}$	$MSR = \frac{SSR}{r-1}$	$\frac{MSR}{MSE}$
Household (main effect- column)	c-1	$SSC = \frac{1}{rn} \sum_{j=1}^{r} Cj^2 - \frac{G^2}{rcn}$	$MSC = \frac{SSC}{c-1}$	$\frac{MSC}{MSE}$
Error	Total-row-col. = n-r-c+1	SSE = TSS -SSR- SSC	$MSE = \frac{SSE}{rc(n-1)}$	
Total	n-1	$TSS = \sum_{i=1}^{r} \sum_{j=1}^{c} Yij^2 - \frac{G^2}{rcn}$		

df = Degrees of freedom
r = row
c = column
n = Total number of observation

SS = Sum of Square
SSR= SS Row
SSC = SS Column
SSE = SS Error
TSS=Total Sum Square
G = Grand sum

MS=Mean Square
MSR = MS Row
MSC=MS Column
MSE= MS Error

References: Snedecor and Cochran (1989); Kleinbaum *et al.* (1988).

(b) Sample Correlation Coefficient

$$r = \frac{\sum_{i=1}^{n} (Xi - \overline{X})(Yi - \overline{X})}{[\sum_{i=1}^{n} (X - \overline{X})^2 \sum_{i=1}^{n} (Yi - \overline{Y})^2]^{1/2}}$$

Where, r = Sample correlation coefficient
X_i and Y_i are two series of variables
n = Total number of observation
$\overline{X}$ and $\overline{Y}$ are sample means of the two series of variables
$\sum$ = Summation

(c) The R *X* C Contingency Table for χ^2 Analysis

Calculation of χ^2 Value:

$$\chi^2 = \frac{(O - E)2}{E}$$

Where, χ^2 = Chi square value
$\sum$ = Summation
O = Observed frequency
E = Expected frequency

Calculation of expected frequencies:

$$E = \frac{RTXCT}{GT}$$

Where, E = Expected frequency at the particular cell of the contingency table
RT = Row total
CT = Column total
GT = Grand total

(d) Multiple Regression Model

The general form of a **regression model** for k independent variables is given by

$$Y = ß_0 + ß_1X_1 + ß_2X_2 + \ldots + ß_kX_k + E.$$

Where, $ß_0$, $ß_1$, $ß_2$, … $ß_k$ are the regression coefficients needed to be estimated. The independent variables X_1, X_2, ..., X_k may all be functions of a few variables, and E refers to error of estimate (Kleinbaum *et al.*, 1988).

The ANOVA Table for Multiple Regressions:

Source	df	SS	MS	F	R^2
Regression	k	SSY-SSE	MSR= $\frac{SSY - SSE}{k}$	$\frac{MSR}{MSE}$	$\frac{SSY - SSE}{SSY}$
Residual	n-k-1	SSE	MSE = $\frac{SSE}{n - k - 1}$		
Total	n-1	SSY	MSY = $\frac{SSY}{n - 1}$		

df = Degrees of freedom
k= No. of independent variables
n = Total no. of observation

SS= Sum of square
MS= Mean square
SSE= Sum square residual
SSY= Sum square total
MSE= Mean square residual
MSY= Mean square total

Reference: Kleinbaum *et al.* (1988).