Mekelle University
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Identifying Challenges and Opportunities on the Development of Sustainable Vegetable Agro-industries in the National Regional State of Tigray

By

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A Thesis

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DECLARATION

This is to certify that this thesis entitled "Identifying Challenges and Opportunities on the Development of Sustainable Vegetable Agro-industries in the National Regional State of Tigray" submitted in partial fulfillment of the requirements for the award of the degree of MA in Development Studies to the College of Business and Economics, Mekelle University, through the Department of Management, done by Mr. Girmalem Nirea Kahsay, Id. No. CBE/PR102/02 is an authentic work carried out by him under our guidance. The matter embodied in this project work has not been submitted earlier for award of any Degree or Diploma to the best of our knowledge and belief.

Name of the Student _____ Signature & Date _____

Name of Principal Advisor _____ Signature & Date _____

Name of co-Advisor _____ Signature & Date _____

Name of Internal Examiner _____ Signature & Date _____

DEDICATION

I dedicate this thesis manuscript to my father the late Nirea Kahsay, my mother Letay Alemayoh and my brothers Kibrom and Berhe for their boundless love and affection

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ABSTRACT

This research was commenced with the objective of identifying the major challenges and opportunities on the development of sustainable vegetable agro-industries in the National Regional State of Tigray. There is unexploited capacity on the production of vegetables that can provide sufficient inputs for vegetable agro-industries and both the amount of area coverage and yield per hectare of vegetable production are increasing from time to time in the region. However, there are not vegetable agro-industries that could transform the vegetable production sector and enhance the income of growers. Hence, a research is required to answer the question why there are not vegetable agro-industries in the region. One way of answering this question is to detect the major challenges and opportunities on the development of such industries.

As a result, this thesis has detected some challenges and opportunities taking the case of Enderta wereda through applying key informants method of data collection. Since the data collected are qualitative, the data analysis is performed in such a way that the researcher first edited the data to ensure the completeness, consistency and meaningfulness and then interpreted them based on the literature on hand. Some of the challenges detected by this research are increasing price and scarcity of agricultural inputs, weak rural infrastructure, low attitude of investors, and lack of capital and expertise. The ongoing increase in vegetable products, favorable policy environment and increasing demand for processed vegetables are some of the identified opportunities.

Finally, the researcher recommended that the current increase in the production of different vegetables should keep on by incorporating quality controlling mechanisms so that sustainable supply of raw materials could be assured for the intended vegetable agro-industries; the development of vegetable agro-industries should be in a sustainable way so that they offer permanent employment, generate income tax and profit for the concerned stake holders; and the development of vegetable agro-industries must be environmental friendly.

Key words: vegetable agro-industries, sustainable development, challenges, opportunities

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LIST OF ABBREVIATIONS

AfDB	African Development Bank
AGOA	African Growth and Opportunity Act
AU	African Union
BoARD	Bureau of Agriculture and Rural Development
BoFED	Bureau of Finance and Economic Development
BoTIUD	Bureau of Trade, Industry and Urban Development
COMESA	Common Market for Eastern and Southern Africa
CSA	Central Statistics Agency
FDG	Focus Group Discussion
FDRE	Federal Democratic Republic of Ethiopia
FAO	Food and Agricultural Organization
GDP	Gross Domestic Product
GTP	Growth and Transformation Plan
HDE	Horticulture Development Enterprise
IBEF	Indian Brand Equity Foundation
IBIS	International Business Information System
IFAD	International Fund for Agriculture Development
MARC	Mekelle Agricultural Research Center
MDGs	Millennium Development Goals
MoFED	Ministry of Finance and Economic Development
NAICS	North American Industry Classification System
REST	Relief Society of Tigray
SADC	Southern Africa Development Community
TAMPA	Tigray Agricultural Marketing Promotion Agency
TARI	Tigray Agricultural Research Institution
UAAIE	Upper Awash Agro-industry Enterprise
UNIDO	United Nations Industrial Development Organization
WHO	World Health Organization

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CHAPTER-I

INTRODUCTION

1.1. Background of the Study

The sectors of agriculture and industry have been customarily viewed as two separate sectors in terms of their characteristics and the role they played in the economic progress of a given country. The agricultural sector was considered to be the attribute of the first stage of development; at the same time as, the industrial sector was taken as the most relevant indicator of a country's economic progress. Likewise, the agricultural sector was obliged to finance the shift of the economy from agriculture to a kind of industry that deters completely from agricultural industrialization. This shift was considered as the proper strategy for a country's progress along the development path (FAO, 1997).

However, such kind of view no longer appears to be appropriate. This is because the fact that agriculture by itself has become industry considering the different technologies applied on the production, processing, transportation, and marketing of agricultural products. This reality specifies that agricultural industrialization and thereby agro-industrial development are combined processes that create new type of industrial sector (FAO, 1997).

The development of sustainable agro-industries has the advantages of income generation and employment creation both in farming and non-farming activities; can reduce poverty among the populations of both the rural and urban communities, which is one of the key Millennium Development Goals (MDGs) (AU, 2010); it can be a means of export earnings (Narin and Shamsul, n.d.); it can provide the rural people with off-farm employment such as handling, packaging, transporting and marketing of the agro-products (Stjepan, 2007); and it contributes a lot in enhancing the quality of agro-products and raises the demand for these products (Carlos et al, 2009). From this fact we can understand that a better handled and well developed agro-industry opens room for vast employment and plays great role on the economic enhancement of a given country.

In a similar way, a sustainably developed vegetable agro-industry can generate employment, improve resource productivity, commercialize vegetable products, and improve health and diet of consumers (Mubarik, n.d.). A vegetable agro-industry, in this sense, can be broadly defined as the chain of production, processing, transportation, storage, financing, marketing and distribution of vegetable products (http://www.goyangkarawang.org Retrieved 07/03/2011).

For more preciseness, vegetable agro-industries are those industries which process vegetables in two mechanisms (http://www.p2pays.org Retrieved 21/03/2011; John, 2004). The first one is fresh packing in which vegetables are first stored in cold storage immediately after their harvest and then packed in cold containers and become available for market in fresh form (http://www.p2pays.org Retrieved 21/03/2011). In the second mechanism, vegetables share the first step, which is the cold storage of vegetable products after harvest, and then enter into processing plants that implement such activities as coring, slicing, dicing, pureeing and juicing and then become available for the market as canned vegetables (http://www.p2pays.org Retrieved 21/03/2011).

Vegetable agro-industries contribute to the economic progress of any country in many ways. They offer additional income for the vegetable growers and traders (Johnson et al, 2008) and they have great nutritional and health value for their consumers (Johnson et al, 2008). They are also export oriented and are very labor-demanding (Marc and Stefan, 2007). This makes economical to run such industries in countries with cheaper labor available (Temu and Marwa, 2007).

Africa has high potential of agro-industrial development. The continent holds appropriate climate which is suitable for the production of different agricultural products (Leon, n.d.). Similarly, market access is becoming an opportunity with the creation of trade areas at regional level and with preferential trade agreements with certain countries. Urbanization and subsequent food diversification are also other opportunities (Leon, n.d.). However, such challenges like low agricultural productivity, high post-harvest losses, low access to technology, lack of infrastructure for commercialization and processing, unable to meet market demands and others (Leon, n.d.) cause the development of the agro-industrial sector to be very slow. Besides, the high cost of construction, operation and maintenance restrict the vast development of agro-industries in the continent (Temu and Marwa, 2007).

Coming to Ethiopia, the country possesses favorable agro-climatic condition, which is good opportunity for the development of different kinds of agro-industries. However, there are small number of agro-industries is the country (Tessema, 2001; http://edepot.wur.nl/12 Retrieved 22/01/2011). There were 2,203 medium and large scale manufacturing industries in 2008/2009; of which 562 were food and beverage manufacturers (CSA, 2009). Five of these manufacturers were fruit and vegetable processors; which process tomato paste, orange marmalade, vegetable soup, frozen vegetables and wine (Rolien and Andre, 2009). Tigray, one of the nine regions of Ethiopia, consisted 36 food and beverage manufacturing companies in the year 2008/2009 (CSA, 2009); however, none of this companies engaged in vegetable agro-industry.

1.2. Statement of the Problem

It is a well recognized fact that most vegetables are perishable by nature. This nature makes vegetables not to be stored for long time. The majority of vegetables stay unspoiled for a few days and some for a few weeks (Peter, 2004). Usually, there is a time gap between harvest and consumption periods (Eric, 2006). This facilitates the spoilage of vegetable products; as a result, growers are obliged to dispose vegetables even at an unattractive price (Subrahmanyam, 2000). Besides, vegetables have seasonal nature wherein most vegetables are available for short time annually. This seasonality nature results in low prices of vegetables during peak production periods, which may not cover even the production and transportation costs (Subrahmanyam, 2000).

Hence, some value adding activities are required to preserve the quality of vegetable products. Vegetable processing, being one of such activities, can increase the shelf life of vegetable products and create convenience for consumers when utilizing the products (Eric, 2006). Alongside with this, activities like refrigerated transportation and cold storage can make vegetables remain fresh and of good quality for extended time (Wiersinga, et al, 2008). Both activities are parts of the vegetable agro-industry. The introduction of such activities can sustain the supply of vegetable products through paying growers an income that encourage future production.

The number of vegetable agro-industries is limited in Ethiopia (Rolien and Andre, 2009; Shimelis, n.d.). There are only two privately owned cold stores, the Ethio-flora and Tippu Valley

cold stores at Ziway; three low standard cold stores one at each of the three state owned enterprises, which are the Upper Awash Agro-industry enterprise (UAAIE), Horticulture Development Enterprise (HDE), and Etfruit (Rolien and Andre, 2009). The Ethiopian Airlines has also introduced one high standard cold store at Bole International Airport (Rolien and Andre, 2009). Except the stores at UAAIE and Etfruit, which are available for fruits and vegetables, all the rest cold stores are designed for the Ethiopian floriculture (Rolien and Andre, 2009). There are only three vegetable processing plants which process tomato paste, vegetable soup, and frozen vegetables in the whole country (Rolien and Andre, 2009). For this reason, the country is not getting the possible amount of foreign exchange from the sector besides the loss of foreign currency for the import of processed products (Shimelis, n.d.).

The National Regional State of Tigray is one of the nine regions of Ethiopia. The natural and manmade calamities such as erratic rain-fall, severe deforestations, and land degradations (Hailesillassie and Gebrehiwot, 2010) decline vegetable production and this poses a challenge on the development of sustainable vegetable agro-industries.

Besides, the road density of the region is only 51km per 1000km^2 (www.agrimartg.org Retrieved 21/11/2010). This may create a problem on the transportation of both raw materials and outputs of vegetable agro-industries. There is also a problem of communication in the region. The fixed line, mobile and total telephone density per hundred persons is only 1.16, 1.6, and 2.77 respectively (www.agrimartg.org Retrieved 21/12/2010). This can create communication problem on the supply and marketing chains of vegetable agro-industries. When we come to electric supply, most of the urban centers are supplied with 24 hour hydroelectric power; however, the majority of the rural areas have not yet supplied with an electric power. This will have its own impact on the refrigerated storage of vegetable products within the rural areas.

Despite these problems, the current introduction of various water harvesting schemes such as micro-dams, ponds, shallow wells, diversions etc; as well as community participation based land reformation activities create favorable condition for the expansion of horticultural crops, especially vegetables, in the region (Hailesillassie and Gebrehiwot, 2010). The National Regional State of Tigray has the capacity to irrigate 3220 km^2 or 322,000 hectare of land; however, 40 km^2 or 4,000 hectare of land, which is only 1.2%, is being irrigated currently (www.agrimartg.org

Retrieved 21/11/2010). This shows that the region has unexploited capacity on the production of vegetable products, which can supply sufficient raw materials for vegetable agro-industries.

Both the amount of area coverage and yield per hectare of vegetable production are increasing from time to time in the National Regional State of Tigray. However, there are not vegetable agro-industries that could transform the vegetable production sector and enhance the income of growers in the region. Hence, a research is required to answer the question why there are not vegetable agro-industries in the region. One way of answering this question is to detect the major challenges and opportunities on the development sustainable vegetable agro-industries. Accordingly, this thesis has commenced to identify the major challenges and opportunities on the development of sustainable vegetable agro industries in the region and has proposed some ways of developing sustainable vegetable agro-industries by taking the case of Enderta Wereda.

Research Questions

The thesis addressed the following research questions:

1. What is the current situation of vegetable supply in Tigray?
2. What challenges obstruct the development of sustainable vegetable agro- industries?
3. What opportunities favor the development of sustainable vegetable agro-industries?
4. How could sustainable vegetable agro-industries develop in Tigray?

1.3. Objectives of the Study

1.3.1. General Objective

The general objective of the thesis was to promote the development of sustainable vegetable agro-industries in the National Regional State of Tigray through identifying the key challenges and opportunities.

1.3.2. Specific Objectives

The specific objectives of the thesis include:

1. to assess the current condition of vegetable supply in the National Regional State of Tigray
2. to identify particular opportunities on the development of sustainable vegetable agro-industries
3. to detect key challenges that confront on the development of sustainable vegetable agro-industries
4. to suggest strategies on the development of sustainable vegetable agro-industries in Tigray

1.4. Significance of the Study

The results of this thesis could serve as supplementary data for policy makers who concern on the development of vegetable agro-industries. It might assist them in designing appropriate vegetable agro-industrial development policies. Farmer cooperatives, vegetable growers, vegetable traders, and other interested bodies would have the possibility of using the results when they attempt to develop sustainable vegetable agro-industries. Moreover, the thesis could serve as a source of secondary data for further studies.

1.5. Scope and Limitations of the Study

1.5.1. Scope of the Study

The thesis detected the main challenges and opportunities on the development of sustainable vegetable agro industries, which include processing plants as well as the preparation of cold storage, appropriate packaging and refrigerated transport facilities for all types of vegetables grew in the region by taking the case of Enderta wereda.

This thesis applied the key informant way of data collection since there are not direct respondents that could fill questionnaires. The BoARD of Tigray, BoTIUD, TARI, TAMPA, and REST as well as some vegetable traders, supermarkets and eateries in Mekelle city are the key informants interviewed to collect appropriate data. FGD is also conducted with some vegetable growers in

Gereb Giba Tabia (sub-district), which is one of the potential vegetable suppliers of the region within Enderta wereda (district). The thesis has detected the main challenges and opportunities on the development of sustainable vegetable agro-industries in the National Regional State of Tigray based on the literature on hand.

1.5.2. Limitations of the Study

Albeit it carried out cumbersome efforts to collect necessary data, the study doesn't have detailed information on the amount of vegetables that could be ready for processing. Data on the amount of vegetable production in Tigray is available from BoARD and the CSA; however, data on the amount of vegetables supplied from growers outside the region, amount of fresh vegetable products sold inside and outside the region, as well as amount and reason of spoilage on vegetables are not readily available. This puts a limit on the estimation of products that could be raw materials for vegetable agro-industries.

It was also unable to find some concerned informants like those investors who take land from the government to construct vegetable agro-industries, which are tomato sauce and tomato juice, but not yet started the business. This is due to the reason that some of the investors were outside Mekelle for long time and some were not interested for the interview. Besides, the researcher has taken only one wereda and one sub-district from that wereda to collect data from vegetable growers, which may not represent the whole vegetable growers of the region.

1.6. Organization of the Paper

This paper is organized as follows. The first chapter is the introductory part which includes background of the study, statement of the problem, research objectives, significance of the study and scope and limitations of the study. The second chapter is review of related literature. The third chapter deals with research methodology. The fourth chapter presents the results and discussions of the study and the last chapter is the conclusions and recommendations part. Additionally, references and appendices are provided in the last part of the paper.

CHAPTER-II

LITERATURE REVIEW

2.1. An Overview of Vegetable Agro-industries

2.1.1. Definition

Vegetable agro-industries can be defined as components of manufacturing that process and transform vegetable products derived from the agricultural sector (FAO, 1997). They are types of agro-industries that process vegetable products beyond the farm gate level (Mario et al, 2006); they comprise all kinds of enterprises that use vegetable products as input and process them in whatever way (Stephan et al, 2005).

In other words, vegetable agro-industries are the main types of food processing industries which undertake post-harvest activities that add value to vegetable products in two ways; either packaging them in a fresh form or transforming them in the form of canned foods (http://www.p2pays.org Retrieved 21/03/2011; John, 2004). Such activities lengthen the edibility period of the vegetable products by decreasing spoilage and wastage of the products (Wiersinga, et al, 2008).

2.1.2. Importance of Vegetable Agro-industries

Vegetables are important elements of healthy diet, in which, if ate on a daily basis adequately, they have the power of protecting various kinds of diseases like cancer, diabetes, heart disease and obesity; accompanied by preventing micronutrient deficiencies in developing countries (FAO and WHO, 2004).

On the other hand, vegetables are types of food that deteriorate readily unless special methods of preservation or processing are employed (Shruti, 2007). One characteristic of vegetable products is that they are less acidic than other types of crops which make them prone to food poisoning bacteria without giving signs of spoilage on their body. As a result, consumers may eat the product devoid of knowing the contamination (Peter, 2004). Therefore, special methods should

be undertaken for careful consumption of vegetable products.

One method is to prepare vegetables that are free of any contamination through different processing activities (Peter, 2004). Vegetable processing activities like preservation and removal of moisture from vegetable products by drying and other value adding processes reduce the number of contaminating micro-organisms within vegetable products and decrease the spoilage and loss level of the products (David and Colin, 1991). Such kinds of activities also preserve vegetables by reducing the speed of spoilage caused by external factors like heat and moisture (Peter, 2004). In addition to this, they change the products into more attractive types of foods which are heavily demanded by and have convenience for consumers (Peter, 2004). Hence, consumers will not be in danger as they consume products of vegetable agro-industries.

As any type of agro-industries, vegetable agro-industries play a central role in income generation (UNIDO, IFAD, and FAO, 2008) and employment generation (Suzanne, 1999), being characterized by a marked presence of women in their workforce (John and Rudi, 2008). Vegetable agro-industries have the potential to provide employment for rural population not only in farming, but also in off-farming activities such as handling, packaging, processing, transporting, and marketing of vegetable products (Carlos et al, 2009). They also contribute to enhancing the quality of and the demand for vegetable products (Carlos et al, 2009). They can provide capital and services to growers (e.g. seeds and equipment, training, production and market information), promote entrepreneurship, and connect growers with markets through the handling, processing, marketing and distribution of agricultural products (UNIDO, IFAD, and FAO, 2008). They are also important since they supply health-giving, safe, nutritious, and acceptable vegetables for consumers throughout the year (Mircea, 1995).

Vegetable agro-industries increase the value of crops, expand marketing opportunities, improve shelf-life and furthermore overcome seasonal and perishable constraints (Norman et al, 2003). Vegetable agro-industries are also important since they derive demand for vegetable products, in which, as vegetable products are processed in such industries, the demand for the products will remain higher helping growers get high prices even at surplus production periods (Narin and Shamsul, 2003). The products from vegetable agro-industries can replace imported products in addition to earning foreign exchange through the export of finished and semi-finished products.

Generally, the development of vegetable agro-industries in developing countries has the importance of economic diversification, promoting industrialization as well as import substitution and export promotion policies, obtaining marketable commodities that stimulate vegetable production, improving nutritional habit, development of new value-added products and others (Mircea, 1995).

2.1.3. Processing Activities

Vegetable agro-industries carry out processing activities which comprises two sections; vegetables packing and processing of vegetable products (http://www.p2pays.org Retrieved 21/03/2011). Parts of operations shared by both sections are cold storage, refrigerated transportation, trimming, washing, grading and packing of fresh products (http://www.p2pays.org Retrieved 21/03/2011). The operation of each section is explained in detail below.

2.1.3.1. Vegetables Packing Section

The vegetables packing section collects fresh products and packs them in lugs or other forms of cold containers (http://www.p2pays.org Retrieved 21/03/2011). The packing section of some leading firms consist of warehouses with concrete floors, aluminum roofs, together with load and unload facilities and cold stores (Steven, 2003). This section implements operations like cold storage, trimming, washing, grading, packing, and refrigerated transportation of fresh products (http://www.p2pays.org Retrieved 21/03/2011). Then the products will be available for market in fresh condition either for final consumption or for further processing (Richard et al, 2005). For example, the Australian vegetable industry supplies fresh potatoes, which are prepared through the use of advanced and labor saving technology in washing, packing, storage and distribution, for three purposes; fresh potato for the food sector, as raw material for the potato processing sector and seed production for the agricultural sector (Richard et al, 2005). The industry also prepares tomato, carrot, lettuce and other fresh products for the same purpose (Richard et al, 2005). All fresh vegetables exported in fresh form from some developing countries like Kenya into the developed world, mainly Europe, could be also taken as illustrative outputs of the fresh vegetables packing section (Marc and Stefan, 2007).

2.1.3.2. Vegetable Processing Section

This section extends the shelf life and adds value for the vegetable products through preparation of raw materials like cleaning, trimming, and peeling followed by activities like freezing, cooking and canning of vegetable products (World Bank Group, 1998). It comprises a set of activities like manufacturing of canned, bottled, preserved, quick frozen or dried as well as dehydrated vegetable products (Stephen et al, 2006). It provides consumers with products that could be prepared easily and have more convenience in consumption (Eric et al, 2008). The North American Industry Classification System (NAICS) classified vegetable processing activities into four sub-sectors. These are:

1. Frozen vegetable manufacturing with such products as frozen French fried potatoes, frozen potato patties and puffs, frozen onions etc

2. Vegetable canning including canned tomatoes like spaghetti and pizza, sauces, ketchup, tomato paste, tomato sauce, salsa, stewed tomatoes, and tomato juice

3. Specialty canning which includes canned soups and stews

4. Dried and dehydrated vegetables like dried and dehydrated potatoes and onions (Eric et al, 2008).

2.1.4. Processing Technologies

2.1.4.1. Vegetables Storage

Since vegetables are perishable products they must be preserved in proper and systematic stores. There are two ways of storage facilities for vegetables. These are the short-term storage facility and the long-term storage facility (Mujibur, n.d.). The first facility must be maintained at grower level and is done locally using indigenous technology (Mujibur, n.d.). The second facility needs modern cold storage types to preserve vast amount of vegetable products (Mujibur, n.d.).

2.1.4.2. Packaging

Packaging materials are important for marketing (FAO, 2009). They are required to be non-toxic, sanitary, transparency, tamperproof, easily opened, and have low cost (Mircea, 1995). In addition to this the packaging materials must have enough strength, convenience on using, suitable size, minimize packaging waste and with environmental concern (Siriwan et al, 2009). Peter (2004) pointed out that:

> When selecting packaging materials, the processor should consider; technical requirements of the product (for protection against light, crushing, air, moisture etc.), the design (for promotional and marketing requirements) and the relative cost and availability of different types of packaging. (p. 25)

Primary and Secondary Packages

Some products like onion, potato, garlic and the like are naturally covered by primary package hence they need only secondary packages like box to hold them jointly for gross protection (Mircea, 1995). Others such as lettuce, cabbage, carrot and green pepper require primary packages like plastic liners and then are packed by secondary packages like cartons (Mircea, 1995). Such packaging ways are required during supplying raw materials for vegetable agro-industries or during selling products as fresh.

Hermetic Closure

This packaging material is absolutely resistant to air and gases. Hence it doesn't permit bacteria, yeast, moulds and other micro-organisms as these organisms are smaller in size than air and gas molecules (Mircea, 1995). Materials like tin can, plastic and films can be used as hermetic packages for products like tomato paste, tomato juice and other types of canned vegetables.

Common packaging materials include plastic sheets for dried vegetables, receptacles for dehydrated/dried vegetables, tin can or tinplates for canned vegetables and glass containers for different kinds of vegetable juices (Mircea, 1995).

2.1.4.3. Refrigerated Transport

Vegetable products are sensitive and require refrigerated transport to remain fresh and stay in good quality during long transport (Wiersinga, et al, 2008). The importance of refrigerated transport can be explained in two ways; one, it offers quality raw materials for vegetable agro-industry through decreasing damages caused due to improper transportation system and second, it offers finished and semi-finished products to reach any destination without damage on their quality.

2.1.4.4. Transformation/ Processing

Basically, all types of vegetables can be processed; however, there must be considerations on the demand of the product in the processed form, the resistant force of the raw material to be processed, and the sustainable supply of the raw materials (Mircea, 1995). Vegetables, which are selected for processing, undergo the following steps (Mircea, 1995):

Reception

Quality control is the principal consideration of any vegetable agro-industry (Mujibur, n.d.). Hence, this step experiences the qualitative and quantitative control of vegetables (Mircea, 1995).

Temporary Storage

In this step, vegetables are stored temporarily in cool, dry, and well ventilated stores without enforced air circulation that induces loss of weight through the evaporation of water from the products before they processed (Mircea, 1995).

Washing

In this step, vegetables are washed to remove pesticides and insecticides applied for their healthier growth in addition to the regular wash for the removal of field soil and surface micro-organisms (Mircea, 1995).

Sorting

This step comprises the removal of vegetables with low standard as well as grading vegetables based on quality (Mircea, 1995).

Peeling

Vegetables' skin is removed in this step through mechanical, chemical, and thermal activities. The mechanical activity applies a machine, knife or rotating sieves to remove the outer layer of different vegetable products; the chemical activity softens the outer layer through the use of different chemicals; and the thermal activity requires steam or wet heat to remove the layers (Mircea, 1995).

Size Reduction

In this step, the size of different vegetable products is diminished according to the technical requirements of the particular vegetables (Mircea, 1995).

Blanching

In this step, vegetable products are moderately heated for the purpose of making enzymes out of action. It is done in a moderate way for the reason that low level of heating is ineffective and high level damages the vegetable products (Mircea, 1995).

Canning

More or less, the final stage of vegetable transformation is the canning step. Vegetables can be canned, pureed, diced or packed as juice (Mircea, 1995).

2.2. Global Trends of Vegetable Agro-industries

There is not information concerning global vegetable agro-industries specifically; but around 5,943 businesses engaged in fruit and vegetable processing in the world in 2007 with of few of them capturing the major share of the international market (IBIS World, 2007). The geographic spread of the industries looks like: North America 28.5%, Europe 18.4%, South East Asia 16.4%, South America 15%, North Asia 10.7%, Oceania 5.6%, India and Central Asia 3.6% and Africa

and Middle East 1.8% (IBIS World, 2007).

North America is the largest region of the global vegetable agro-industry wherein about 70% of vegetables are processed. The industries there include the Far West, Great Lakes, California, Mexico, and Canada. Common products of the region are frozen vegetables like frozen potato. South East Asia is the second largest region which includes countries like Philippines, Thailand and Malaysia as the largest producers utilizing 70-80% of fresh products. Familiar products include processed vegetables like chili peppers pickled in vinegar, ginger drinks, bean curd or tofu. Europe is the third largest region that produces with Germany holding the largest share through its canning industries that manufacture a wide range of pickled vegetables like sauerkraut (preserved cabbage). The fourth region is South America from which Brazil is the largest producing country that utilizes 70% of its fresh products. North Asia and Oceania hold the fifth and sixth rank. China is the largest producer in North Asia in which its strong economic growth results in new processing technologies so that the highest portion of its fresh product is being processed. Processing in Oceania takes place in Australian states mainly in Victoria and New South Wales. India is the largest producers in the India and Central Asia region but only 0.5-1% of its raw products are processed. Israel and South Africa take the biggest share in the African and Middle-East region (IBIS World, 2007).

In general, the global vegetable agro-industries are progressively providing the world demand with their products and the trend tends to be fewer growers, lower prices, larger processors and increasing dominance of major retailers. Regardless of such challenges, however, there are opportunities for the vegetable agro-industries in the future times related with rising world population, urbanization, growing disposable incomes and increasing number of health conscious consumers (Richard et al, 2005).

2.2.1 Best Experience in Vegetable Agro-industries

The Canadian Fruit and Vegetable Canning, Pickling and Drying Industry

The Canadian fruit and vegetable canning, pickling and drying industry can be taken as one best experience in the vegetable agro-industries. The industry has considerably modernized into smaller amount of plants for the purpose of improving its competitive advantage and extended

the range of outputs in order to meet the increasing demand of the world (http://www4.agr.gc.ca Retrieved 21/12/2010). The influence of globalization has altered the industry from protected and domestic-oriented service into open and international-oriented service. Familiar products of the industry include canned vegetables, juices and drinks, cider, dehydrated and dried vegetables, pie filling, horseradish, infant and junior food, vegetable sauces, canned vegetable soups, tomato ketchup, tomato paste, as well as tomato pulp. Maintaining its share of domestic market and increasing its exports are the main challenges of this industry (http://www4.agr.gc.ca Retrieved 21/12/2010). The main reason for the sustainability of the company is its way of managing the sustainable supply of raw materials, which is engaging in the contract farming with the potential vegetable growers of the country.

2.3. Status of Vegetable Agro-industries in Ethiopia

2.3.1. Production of Raw Vegetables

Ethiopia is well recognized country for its favorable agro-climatic conditions for the development of different kinds of vegetable products. The major vegetable growing areas of the country are East Hararghe, East Shewa, West Shewa, Arisi, Gamo Goffa, Dire Dawa, Harari, Tigray and Amhara (Rolien and Andre, 2009). Along with this the Ethiopian government has selected four major areas by giving priority for further production of horticultural crops including vegetables, which are the Tana Beles, Rift Valley, Dedessa Valley and Dire Dawa (Rolien and Andre, 2009).

The growing season of Ethiopia was mainly associated with the annual rainfall, which starts at the end of June in the northern parts and October at the southern parts (Rolien and Andre, 2009). But recently some water harvesting mechanisms are introducing and some irrigational activities are starting to be utilized almost in all regions of the country.

In the year 2009/2010, 138,392.53 hectare of land was covered by different vegetables and 212,208.33 hectare of land by different root crops (CSA, 2010). From these, potato covered 69,783.60 hectare, onion 17,588.41 hectare, garlic 15,361.25 hectare, green pepper 7,849.75 hectare, tomato 4, 952.9 hectare, carrot 2,712.7 hectare and beet root 1,096.31 hectare (CSA, 2010). By that year, 5,573,568 quintal of vegetables and 18,063,778 quintal of root crops was produced; out of this, 5,723,325 quintal potato, 1,693,168 quintal onion, 1,796,578 quintal garlic,

614,637 quintal green pepper, 404,461 quintal tomato, 182,293 quintal carrot and 100,785 quintal beet root was harvested (CSA, 2010).

However, it is generally accepted that the production level of Ethiopia is much lower than the national demand (Shimelis, n.d.). Besides, 25-35% of the vegetable product is estimated to loss in the country (Tadesse, 1991; cited in Wiersinga, et al, 2008). In most cases the loss is cause due to the perishable nature of the vegetables and physical damage during handling, transporting and storage (Mubarik, n.d.). The shortage of vegetable agro-industries also exaggerates the loss.

2.3.2. Number of Vegetable Agro-industries

There were 562 food and beverage manufacturing industries in Ethiopia in 2008/2009 (CSA, 2009). However, there is not detailed information on this document regarding how much of these food and beverage manufacturing industries are engaged as vegetable agro-industries. However, according to Rolien and Andre (2009):

> In Ethiopia, the number of fruits and vegetables processing industries is limited. Currently, there are only 5 fruits and vegetables processing plants in the country. These plants presently process a limited variety of products: tomato paste, orange marmalade, vegetable soup, frozen vegetables and wine. Currently most processed products are geared to domestic markets. (p. 27)

Excluding the two fruit processors (orange marmalade and wine), there are only three vegetable processors in the whole country. As a result, growers of different kinds of vegetables in Ethiopia are confronting economic losses due to the small number of vegetable agro-industries (Shimelis, n.d.), which could extend the shelf life of and create market opportunities for their products. In addition to this, the country is not getting the possible amount of foreign exchange from the sector and it is losing foreign currency through importing processed products (Shimelis, n.d.).

Coming to cold storage facilities, there are only two privately owned cold stores (the Ethio-flora and Tippu Valley cold stores at Ziway), and three low standard cold stores at the three state-owned enterprises (Upper Awash Agro-industry enterprise (UAAIE), Horticulture Development Enterprise (HDE), and Etfruit) (Rolien and Andre, 2009). There is also one high standard cold

store at Bole International Airport (Rolien and Andre, 2009). Most of these cold store facilities are prepared for the Ethiopian floriculture except the cold stores at UAAIE and Etfruit, which give their service for fruits and vegetables, (Rolien and Andre, 2009).

2.4. Challenges of Vegetable Agro-industries

2.4.1. Perishable Nature of Raw Vegetable Products

Since vegetables have perishable nature, their quality starts to lose just after their harvest and keep on throughout the process until they are consumed. Micro-organisms and natural enzymes change the color, texture and flavor of raw vegetables quickly than other types of crops such as cereals. This behavior of vegetables limit the time they could stay unspoiled before they are processed (Peter, 2004). This is the most serious problem which poses challenge on development of sustainable vegetable agro-industries.

The high amount of post-harvest loss is caused mainly by the perishable nature of vegetables which include physiological decay and water loss (Mubarik, n.d.). The lack or shortage of enough cold storage facilities in vegetable agro-industries exaggerates this problem (Thomas et al, 2005) and lead processors to loss.

Vegetable agro-industries are able to decrease the loss caused by the perishable nature of raw vegetables and extend their shelf life through effective and quality handling techniques during transportation and storage; as well as the utilization of modern processing and preservation technologies (Eric, 2006; Shimelis, n.d.), however, such activities require a great deal of investment which may exceed the short-term return on investment.

2.4.2. Seasonality of Raw Vegetable Products

Most vegetables are produced in a certain season. Such system of production directly influences the marketing conditions of the vegetables (Adugna, 2007). Seasonality of vegetable products may result in scarcity of raw materials for vegetable agro-industries, which is the most serious problem of these industries (FAO, 2009). This problem comes into view when there is departure of vegetable products from markets as their production period passed. On the other hand, if there is excess supply of the products during the peak production periods, problems like shrink of price

of vegetable products, high amount of spoilage and others will result. Excess supply of vegetable products in the market place is one of the reasons for high amount of post harvest losses (Mubarik, n.d.).

Besides, due to the reason that most vegetables are grown under rain fed conditions the supply fluctuates seasonally. The season of lowest vegetable supply in Ethiopia is, for example, the main rainy season between June and mid September when also prices are the highest (Girma, n.d.). Between October and January there are moderate supply of fresh vegetables but starts to rise in February and reaches its peak level in April and May (Girma, n.d.). This irregular and low supply of vegetable products could create a gap between primary processing capacity and the provision of raw materials (Stjepan, 2007).

2.4.3. Poor Infrastructures

Poor infrastructure such as inadequate transportation, poor distribution, inadequate cold storage and freezer capacity, lack of potable water and unreliable power supplies are some of the main shortcomings (Alastair, 2007) in the development of sustainable vegetable agro-industries. Each of this are explained in detail below.

2.4.3.1. Cold Storage

Inadequate cold storage is also one of the main challenges in the development of sustainable vegetable agro-industries (Alastair, 2007). Lack of cold storage facilities raise the seasonal effect of vegetables that disrupt the supply of sufficient amount of raw materials required for sustainable processing activities.

2.4.3.2. Transport

Inadequate transportation is one of the main challenges in the development of sustainable vegetable agro-industries (Alastair, 2007). Most of the rural areas in developing countries are not accessible by vehicle; as a result, the vegetable products produced there are transported to the road side by donkeys or by people (Bezabih and Hadera, 2007). This requires longer time to reach the market and affects the quality of the products (Bezabih and Hadera, 2007).

By one estimate, internal handling and transportation of goods takes over 1.5 months on average

in Africa, versus 29 days in Latin-America and 13 days in developed countries (www.un.org/esa/sustdev/publication Retrieved 07/12/2010). However, since vegetable products have perishable nature, they start to spoil rapidly before their final destination. Hence, they require technologies such as refrigerated transport (Wiersinga, et al, 2008) in order to delay their shelf life.

2.4.3.3. Supply of Electric Power

Unreliable power supply is also another challenge that delays the sustainable development of vegetable agro-industries (Alastair, 2007). The supply of electric power should not be limited on the urban and pre-urban centers. It must give focus too for the rural and remote areas.

2.4.3.4. Supply of Potable Water

Lack of clean surface and ground water poses challenge on the development of sustainable vegetable agro-industries (Alastair, 2007). Water is required in the processing activities like washing of raw and processed products, peeling, pitting, blanching, sorting, conveying and cooling (http://www.p2pays.org Retrieved 21/03/2011). Besides, potable water is required as an ingredient of some products and for washing down processing equipments (Peter, 2004). Therefore, water is the most vital mineral for vegetable agro-industries that shortage of it poses great challenge on the development of the industries.

2.4.3.5. Communication

Inefficient means of communication limits the flow of marketing and other related information (Bezabih and Hadera, 2007). This is one challenge on the development of vegetable agro-industries. Besides, overstressed mobile phones and slow internet connections, which are frequent problems of developing countries, are considered to be serious challenges on the development of vegetable agro-industries (Rolien and Andre, 2009).

2.4.4. High Post-harvest Losses

About 70% of fruits and vegetables products are estimated to be post-harvest losses in Sub-Sahara African countries (UNIDO, 2007; cited in Leon, n.d.). Some of the reasons for this high amount of losses are surplus supply during peak production seasons, improper handling that

results in physical damage, and natural decay (Mubarik, n.d.). In addition to this, the complexity of collecting and transporting products from several land holdings into the market as well as the warm and humid climate within these countries facilitates the problem (Mubarik, n.d.).

2.4.5. Lack of Focus on Agro-industry

The focus given to the level of capacity building in agro-industry is very low as compared to the focus give to production extension (Leon, n.d.). As a part of agro-industry the vegetable agro-industry also accepts little focus on its development the largest focus being on the development of vegetable products. There is an idea of producing for fresh products marketing rather than producing for industrial marketing (Narin and Shamsul, n.d.). Such idea must be overcome and the production system must include strategies for supplying agro-industries with sufficient raw materials.

2.4.6. Lack of Technical Expertise

Lack of technical expertise in the vegetable processing limits the development of vegetable agro-industries (Navindra, 2003). In most cases there is shortage of expertise in the determination of shelf life, on methods of preservation and packaging, and little knowledge on the processing equipments (Navindra, 2003). Besides, being reliant on outdated processing technologies restrains the development of modern vegetable agro-industries; therefore, there is a need for innovation of new production technologies (Stjepan, 2007) and support in terms of upraising technical knowhow (Navindra, 2003).

2.4.7. Low Access to Financial Services

Low access to financial resources has straight implications in the development of sustainable agro-industries (Leon, n.d.). The basis for the development of vegetable agro-industries is the availability of finance. If there is not enough amount of finance, it is impossible to begin any business. The actual fact in developing countries is that commercial banks are unaffordable for many small-medium entrepreneurs (Leon, n.d.) due to their high rate of interest, the need for collateral and other constraints. This financial constraint is further overstated when it has to service to start-up business in agro-industry (Leon, n.d.).

The banking sector of many countries in Africa is not well developed and in many of these countries it is under state (Temu and Marwa, 2007). This results in allocation of credit to the private sector and directing of available debt to inefficient state enterprises; besides, the commercial credit is available only to some large enterprises that can meet such collateral requirements as urban real estate and others (Temu and Marwa, 2007).

2.4.8. Doubt in the Marketing of the Outputs

Uncertainty on the marketing of the products of vegetable agro-industries restricts the development of such industries. This mainly results from the narrow markets which are the most important limits to the locally processed vegetables (Navindra, 2003).

2.5. Opportunities of Vegetable Agro-industries

2.5.1. Favorable Agro-climatic Conditions

Perfect agro-climatic conditions for growing tropical crops is one opportunity for the development of sustainable vegetable agro-industry since there will be a continued supply of raw materials (Temu and Marwa, 2007). Unlike the developed countries, which have temperate climatic zone where the production of vegetable crops is limited to seasonality, most Sub Saharan African countries hold tropical climate which is suitable for the production of different vegetables (Temu and Marwa, 2007). Favorable climate and ample irrigational possibilities make one region possible for the growth of variety of vegetable crops (Rolien and Andre, 2009).

2.5.2. Appropriate Policy Environment

Appropriate policy environments that include tax holidays, constructive financing possibilities, advantageous terms of loan and little room for corruption (Rolien and Andre, 2009) are the most important ingredients of the vegetable agro-industrial development. According to Alastair (2007):

> Policy instruments for agro industrial development include, among others, Regulation of technology transfer and industrial ownership; Fiscal incentives for research and development, as well as training; Financing of operations through risk capital contribution; Unrecoverable financing for research and infrastructure;

> Pre-and- Post graduate studies scholarships; Commercial protection and foreign investment regulation; Private and public sector purchases and investment, and commercial liberalization. (p. 7)

The development of sustainable vegetable agro-industries, therefore, steps forward through formulating facilitating government policies like customs duty exemption, income tax exemption, remittance of funds, and investment guarantee (Rolien and Andre, 2009).

2.5.3. Increasing Vegetable Production

Vegetable production is growing at fastest annual rate (up to 3.6% annually) in the last years (Mubarik, n.d.). It has reached 876 million tons in 2004 from 255 million tons in 1970 at global level (Mubarik, n.d.). Developing countries have high contribution for this growth; even though the highest contribution came from China (Mubarik, n.d.). During these years, 40% of the increase in horticultural crops (including vegetables) came from developing countries, 52% from China and 8% from developed countries (Mubarik, n.d.). These figures show that the vegetable production of developing countries is increasing with a considerable rate.

2.5.4. Increasing Demand and Export Possibilities

The continuing population expansion and raise in per capita income opens a room for the consumption of processed food products (UNIDO, IFAD, and FAO, 2008). Besides, the increase in urbanization gives value to the importance of food preservation; likewise, such demographic changes like increasing number of women in labor markets, ageing of the population and the increment of single-person households enhance the consumption of readymade and convenience agro-industrial products (UNIDO, IFAD, and FAO, 2008).

In a similar manner, the beginning of such markets as SADC, COMESA, and AGOA give an opportunity for the agro-industrial products through the export towards African and American countries. Besides, SADC and COMESA are free trade zones for some African countries, in which their products could transfer without charge on custom duties enabling them to compete with other imported products (Navindra, 2003).

2.6. Sustainable Development of Vegetable Agro-industries

Sustainable development is defined as development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs (Kathy, 2008; Giles et al, 2007). In the same manner, it can also be explained as the way of promoting economic activity without endangering the environment (Nobutaka, 2009). Sustainable development also means thinking of the future (Amin, 2001). Based on these definitions, sustainable development of vegetable agro-industries can be defined as the development of vegetable processing industries in a continual way through insuring the persistent supply of raw materials and persistent market availability for the outputs together with giving value to the environment. It will therefore incorporate the fair utilization of resources, scientific disposal of wastes and profitable way of operations to ensure balance on the environmental and business concerns.

2.6.1. Sustainable Supply of Raw Materials

Vegetables products are different from other products by their seasonal nature which makes them unavailable throughout the year (Adugna, 2007). This poses challenge on the operation of vegetable agro-industries, which depend greatly on the supply of raw vegetables (Saso, 2010). Two methods are worthwhile for a continued operation of vegetable agro-industries; either buying sufficient raw materials during the short harvesting period and part-processing them so that they stay in temporary storage, or processing a sequence of vegetable crops as they come into season (Peter, 2004).

Similarly, supply of raw materials in a sustainable way can be ensured through the three methods of backward linkages, namely; contact farming, captive farming and cooperative farming (Subrahmanyam, 2000). Contract farming and captive farming are the most common ways for vegetable agro-industries (Subrahmanyam, 2000). These two ways are explained below.

2.6.1.1. Contact Farming

The idea of contract farming is one method that should be implemented for sustainable supply of raw materials. Contract farming is defined by Roy (1972:3; cited in Flavia, 2001) as “those

contractual arrangements, either oral or written, between farmers and other firms, specifying one or more production and marketing conditions of an agricultural product." Accordingly, vegetable agro-industries could implement contractual agreements with potential vegetable growers to ensure sustainable supply of raw materials for their operation. Such agreement is completely different from commercialization because it affects the growers' decision through exerting control on production practices, pricing, quality and credit (Flavia, 2001). It could be done through purchase contract for produce from cultivators at fixed price or by supply of seed, technical knowhow or other inputs in addition to the purchase agreements (Subrahmanyam, 2000). According to Flavia (2001):

> The objective of contractual arrangements is to guarantee sourcing to the firm and control quality. Most of them provide funding to contract growers, but some of them also work with "non-financed" producers. However, the contract specified the amount of land on which crops will be grown, the quality requirements to be met, and the price to be paid. The farmer commits to follow the technical instructions provided by the firm's authorized personnel, and to sell all the harvest to it. In most cases, the product belongs to the grower until it is delivered to the firm. Furthermore, the firm commits to provide technical assistance to the grower, and to purchase his production as long as it meets the specified quality requirements. (p.16)

Such arrangement has numerous advantages for both sides. Vegetable growers will be provided, beyond the sales opportunity, technical assistance, hare the production risks with the vegetable agro-industries and obtain funding for the production process (Flavia, 2001). On the other side, vegetable agro-industries reduce transaction costs and assure the sustainable supply of raw materials through such contract (Flavia, 2001). Engindeniz (2007) elaborates this as:

> Contract-based agriculture is very useful both for farmers and companies. The companies may obtain the necessary high quality raw materials at certain prices and under reasonable purchasing conditions. The companies are simultaneously involved in the issues concerning the raw material to be purchased, such as seeds, fertilizers, seedlings and agricultural chemicals. Due to the fixed price set in the

contract documents, companies can easily calculate their cost, which leads to a clear forecast of future market conditions. Under non-contract, prices are determined according to the prevailing market conditions. (p. 7-8)

2.6.1.2. Captive Farming

In this system, the vegetable agro-industries grow the raw materials by themselves through acquiring or leasing ample area of land; this make the vegetable agro-industries not to depend on other growers and to obtain sufficient supply of raw materials both qualitatively and quantitatively (Subrahmanyam, 2000).

This method is applicable only in the cases where uncultivated land could be used for erecting structures and where there is intensive cultivation that requires small area like mushrooms (Subrahmanyam, 2000). In cases where there are land-limit laws and where rural lands are owned by several small holder growers this system fails to be appropriate (Subrahmanyam, 2000). This is due to the fact that vegetable agro-industries could not obtain land that could produce as enough raw materials as their capacity requires.

2.6.2. Sustainable Markets

Sustainable market is obtained through pursuing a series of stages; conducting feasibility study, selecting the right product, developing marketing and selling strategy, and customer care (Barrie et al, 2008). Each of these stages is clarified below.

2.6.2.1. Conducting Feasibility Study

Vegetable agro-industries are primarily required to have good ideas on vegetable processing. Then, conducting feasibility, which has an objective of discovering whether the proposed ideas are feasible or not in the ground, study will follow (Barrie et al, 2008).

2.6.2.2. Selecting the Right Product

Once the feasibility study is conducted the right product will be selected. The right product is the product with high demand which is determined by conducting a short market survey (Barrie et al, 2008). The paramount way for conducting market survey is to ask people for their views on the

product and their quality as well as asking them how much of the product they will buy, how often and for what price (Barrie et al, 2008).

2.6.2.3. Developing Marketing and Selling Strategy

Marketing and selling are two different things; the first one is to decide what to do to meet customer's demand and how to make more competitive products and the latter is the action on the side of customers on buying the product (Barrie et al, 2008). Vegetable agro-industries should develop good marketing strategy to pave the way for successful selling (Barrie et al, 2008). Some of the marketing strategies that result in well selling are attractive packaging and brand image, best promotion and distribution practices as well as better knowledge of the marketing mix (Barrie et al, 2008).

2.6.2.4. Customer Care

Vegetable agro-industries give care for their customers when they recognize that their customers are the most essential people (Barrie et al, 2008). Because any business survives as long as its customers are satisfied, vegetable agro-industries should implement actions that signify their customers' essence by focusing on their satisfaction (Barrie et al, 2008).

Different kinds of consumers purchase vegetable products in different ways (FAO and WHO, 2004). The different types of consumer are classified as auto-consumers, who grow and process their own vegetable products, and market-dependent consumers, who depend on the market for vegetable products (FAO and WHO, 2004). The latter are further classified as household consumers, who purchase vegetable products for the consumption on their home, and institutional consumer groups which include schools, worksites, hospitals, military, prisons, and feeding programs (FAO and WHO, 2004). Therefore, vegetable agro-industries should be familiar with the different types of vegetable consumers and should build up their business in sites where greater number of household and institutional consumers are found and not in the sites where auto-consumers dominate.

2.6.3. Environmental Concern

2.6.3.1. Efficient Use of Resources

One of the main recourses used by vegetable agro-industries is water. Vegetable agro-industries use water for a number of activities including washing, heating, cooling and others (http://www.p2pays.org Retrieved 21/03/2011). However, certain industries have adopted certain practices for water conservation like use of air to remove debris from raw vegetable products, recycling water use, decrease of water volume during peeling and pitting etc (http://www.p2pays.org Retrieved 21/03/2011).

Another resource is electricity which is used in vegetable agro-industries for power motors, conveyor belts, compressed air systems, water pumps, lighting, ventilation, heating and air conditioning systems (Singh and Heldman, 2001; cited in Eric et al, 2008). For one case, the supply of electricity for such high amount of power is preferred to be systems with free greenhouse gas emissions such as hydroelectric power supply, wind power supply, solar system and others rather than diesel or nuclear electric power supplies which are hazardous for the environment. On the other case, it is advisable to utilize the energy more efficiently as a means of decreasing the cost of energy (Eric et al, 2008).

2.6.3.2. Waste Disposal

The vegetable agro-industries are known for the generation of effluent waste that contains high organic loads, cleaning agents, salt and other suspended solids as well as residue of pesticides washed away from the raw vegetable products. The industries also generate solid wastes like discarded vegetables (World Bank Group, 1998). Therefore, effective waste treatment efforts are the greatest requisites for all vegetable agro-industries.

The World Bank Group (1998) has put the following measures for the reduction of wastewater:

> Procure clean raw fruit and vegetables, thus reducing the concentration of dirt & organics (including pesticides) in the effluent; use dry methods such as vibration or air jets to clean raw fruit and vegetables. Dry peeling methods reduce the effluent volume (by up to 35%) and pollutant concentration (organic load reduced

by up to 25%); separate and re-circulate process wastewaters; use countercurrent systems where washing is necessary; use steam instead of hot water to reduce the quantity of wastewater going for treatment (taking into consideration, however, the tradeoff with increased use of energy); minimize the use of water for cleaning floors and machines; remove solid wastes without the use of water; reuse concentrated wastewaters and solid wastes for production of by-products. (p. 316)

CHAPTER-III

DATA SOURCE AND METHODOLOGY

The universal approach of this study is to identify the challenges and opportunities on the development of sustainable vegetable agro-industries in the national regional state of Tigray. It can be classified as an exploratory research since it examines new and unstudied topic (Geberegziabher, n.d.).

3.1. Description of the Study Area

The National Regional State of Tigray is the northernmost Region of Ethiopia. It shares common borders with Eritrea in the north, the State of Afar in the east, the State of Amhara in the south, and the Republic of the Sudan in the west. Excluding Mekelle town, the state's capital, there are five administrative zones: comprising a total of 47 Weredas (districts) and 673 Tabias (sub-districts) (www.tigraionline.com Retrieved 16/10/2010)

Mekelle is the capital city of the National Regional State of Tigray. Some other major cities and towns besides Mekelle include Abiy Addi, Adigrat, Adwa, Axum, Humera, Enda Selassie, Entichow, Korem, Alamata, Maychew, Wukiro, Kuha, and Zalambessa (www.tigraionline.com Retrieved 16/10/2010).

Tigray has a total population of 4,316,988 (CSA, 2007) which is about 5.8% of the total population of Ethiopia. The sex composition is 49.2% male and 50.8 female. 80.5% of the population lives in the rural areas (CSA, 2007). The economically active age group accounts about 51.8 % of the total population. In terms of religion 95.6% of the population are Orthodox Christians, 4% are Muslims, 0.4% are Catholics and 0.1% are Protestants (CSA, 2007). Regarding ethnic composition, 94.98% are Tigraway, 2.6% Agew/Amhara, 0.7% Erob and 0.05% Kunama. Tigrigna is the working language of the state (www.tigraionline.com Retrieved 16/10/2010).

Tigray has various natural resources which facilitate the development of agriculture, agro-industries, and manufacturing and mining industries (www.agrimartg.org Retrieved 21/11/2010). The Region has appropriate climate to grow different crops and it possesses about 322,000 ha of land (220,000 ha in Tekeze river basin, 65,000 ha in Afar and 37,000 ha in Mereb river basin) possible for irrigation. However, of the total irrigable land of the Region, only 4,000 ha (1.2%) is being irrigated currently due to different reasons (www.agrimartg.org Retrieved 21/11/2010).

Enderta wereda is one of the 47 weredas of Tigray, which is found in the southern zone of Tigray. It has a population of 114,297 (CSA, 2007). It is one of the potential vegetable supplying weredas of Tigray. Mereb Meiti and Gereb Giba are the main vegetable producing areas of the wereda that supply different types of vegetables particularly onion and tomato to the local market. The researcher has taken this wereda as representative of the region's vegetable supplying weredas just for convenience.

3.2. Sources of Data

1. Bureau of Agriculture and Rural Development of Tigray (BoARD)

The Bureau of Agriculture and Rural Development of Tigray is one of the core Bureaus of the National Regional State of Tigray. It has selected as one of the key informants for this research

with the intention of exploring the kinds and amount of vegetable products in Tigray, the major challenges faced on the production of these vegetables, opportunities on the vegetable production sector and the activities implemented for the increment of the products

2. Bureau of Trade, Industry and Urban Development of Tigray (BoTIUD)

Investment Development Process is one of the main work processes under the BoTIUD of Tigray. It is selected as one of the key informants for this research; for the reason of gathering data on why there is not vegetable agro-industries in Tigray, are there opportunities and challenges on the development of such industries, and whether there is any support made by the Bureau for the development of vegetable agro-industries.

3. Tigray Agricultural Research Institution (TARI)

TARI is a governmental institution which is mandated for the generation of different technologies that could enhance the production and productivity of agriculture. It is selected as one key informant for the intension of getting information on activities executed by TARI on the enhancement of vegetable production, supports made for and the idea TARI has on the development of sustainable vegetable agro-industries and the major challenges and opportunities in these supports.

4. Tigray Agricultural Marketing Promotion Agency (TAMPA)

TAMPA is also a governmental agency which promotes the marketing of different agricultural products including vegetables. It has an agro-industrial development research office which is selected to be one of the key informants. Information concerning the challenges and opportunities on the marketing of vegetable products, the general marketing status of vegetables, as well as the any support implemented by TAMPA for the development of sustainable vegetable agro-industries has gathered.

5. Relief Society of Tigray (REST)

REST is a non-governmental organization which carries out a number of developmental activities in the rural and urban centers of Tigray. For the reason of obtaining information on the activities done by the organization for the development of sustainable vegetable agro-industries and the

challenges and opportunities confronted for it in implementing these activities, the organization was selected as one key informant.

6. Fresh Vegetable Traders

Fresh vegetable traders have incorporated as key informants to collect data on the source of supply for the vegetables they trade, to whom they sold, challenges and opportunities on the marketing of fresh vegetables as well as the reason why they don't enter into vegetable agro-industries investment yet.

7. Supermarkets

Supermarkets which sold processed vegetables have also added into the key informants for the intention of guessing the market situation of processed vegetables.

8. Consumers

The researcher also incorporated restaurants and cafeteria (eateries) as key informants to examine whether processed vegetable products have demand or not.

9. Vegetable Growers

Lastly, vegetable growers in Gereb Giba sub-district (in near distance toward the north-east side of Mekelle city) were chose as other key informants to have insights about the challenges and opportunities on the vegetable production sector.

3.2. Survey Design and Sampling

The sampling technique applied in this thesis is not probability sampling technique rather the thesis applies the key informant method. This method is best for exploratory type of research where it is impossible to find direct respondents concerning the issue. It is also best for relatively objective data (Geberegziabher, n.d.). This thesis has taken, therefore, five offices, five vegetable traders, five supermarkets, four eateries within Mekelle city and seven vegetable growers in Enderta wereda Gereb Giba Tabia as key informants just for convenience. These respondents are taken as representatives of all allied bodies given the homogeneity among these bodies.

3.3. Data Collection Methods

3.3.1. Primary Data Collection Methods

The primary data was collected from five officials (a chief vegetable expert from the Bureau of Agriculture and Rural Development of Tigray, a socio-economic research expert from the Bureau of Trade, Industry and Urban Development of Tigray, one expert from the vegetable research section of TARI, an agro-processing development chief expert from TAMPA, and one expert from the agro-processing development section of REST), five vegetable traders, five supermarkets, three restaurants and one cafeteria as well as seven vegetable growers by the application of the following primary data collection techniques.

3.3.1.1. Unstructured Interview

Provided that it is best practice for exploratory research (Gebregziabher, n.d.), unstructured interview formulated on the basis of the scientific literature review is conducted to collect primary data from the above key informants. Except the interview with the five officials the rest interviews were conducted in the local language, which is Tigrigna, and latter the results translated into English for the purpose of analysis. For more detail, the English and Tigrigna forms of the interview are attached in the Appendices part at the end of the paper.

3.3.1.2. Focus Group Discussion (FGD)

As a common rule FGD is conducted with a group of seven to twelve participants (Geberegziabher, n.d.). Based on this, one FGD has been conducted with seven vegetable growers found in Gereb Giba Tabia (a vegetable producing area of Enderta wereda), which is one of the potential vegetable suppliers in the region. It has done in such a way that participants raise their perception and point of view on specified points presented by the researcher as check list. The FGD was conducted once and it was open and free of any bias. The check list was firstly prepared in English and then translated into Tigrigna and conducted this way. Latter, the analysis for the results of the FGD is done on spot. The checklist for the FGD is attached in the appendices part of the paper in both languages for more detail.

3.3.2. Secondary Data Collection

Along with the primary data, secondary data was undertaken for the aim of collecting data on the trend of some of the challenges like road density, levels of electric power supply, water supply as well as communication level in the region from the internet. Besides, some available secondary data has collected from the BoARD and BoTIUD.

3.4. Methods of Data Analysis

Most of the data gathered for the purpose of this study are qualitative data. Since qualitative data are largely textual, it is not possible to apply statistical procedures in this thesis to analyze the data. Textual data are not numerical and could not be analyzed using statistical analysis techniques. Hence, the data in this thesis are analyzed by personal interpretations relying on scientific literatures.

As it is stated above, the method of data analysis used for all of the qualitative data in this research is literature based. The analysis is done in such a way that the researcher first edited the collected data to ensure the completeness, consistency, and meaningfulness and then interpreted on the basis of theoretical facts. Therefore, the data collected for this research are analyzed in view of the scientific literature gathered for the purpose of this research with a great care from subjective bias from the side of the researcher.

CHAPTER-IV

RESULTS AND DISCUSSIONS

This chapter presents the results of the unstructured interview and FGD conducted with the key informants as well as the relevant secondary data collected for the purpose of the study. The ideas forwarded on current situation of vegetable supply, challenges and opportunities as well as the way of developing sustainable vegetable agro-industries in the region are presented in detailed explanations. Each finding is supplemented by scientific literatures and findings of other researches and is analyzed in this way.

4.1. Current Situation of Vegetable Production in Tigray

Since the development of vegetable agro-industries heavily depends on the availability of vegetable products, the assessment of the current situation of vegetable production in Tigray has great importance. This section analyzes the position of vegetable production, its level of development and whether it is sufficient for beginning vegetable agro-industries.

4.1.1. Kinds of Vegetables Growing in the Region

As per the FGD participants, onion, tomato, green pepper and lettuce are the most well-known varieties of vegetables growing in the area where the FGD was conducted. Most of the vegetable traders also endorsed that onion, tomato, potato and green pepper are the most common vegetables produced in the region. In connection to this, TAMPA informed that potato, tomatoes, as well as local and improved onion are among the most frequently cultivated vegetables in the region.

4.1.2. Purpose of Vegetable Production

As the FGD participants and TAMPA believed, most of the vegetable are produced for sale within the local market. TAMPA estimated about 90% of the overall vegetables growing in the region is sold in the local market and the rest 10% lingered at home for family consumption.

4.1.3. Trend of Vegetable Production

The region's BoARD believed that the production and productivity of vegetables are increasing from time to time. Both area of land covered by vegetables and yield per hectare are increasing. For example, the amount of land under vegetable cultivation was increasing from 29,000 hectare in 2006/07 to 41,000 hectare in 2007/08, 53,000 hectare in 2008/09, 82,000 hectare in 2009/10 and 120,000 hectare in 2010/11. Similarly, the average yield per hectare for all vegetables was 129, 151, and 160 quintal per hectare in 2008/09, 2009/10 and 2010/11 respectively.

In relation to this, TAMPA indicated that there is an ongoing increase in production and productivity of all vegetable crops. The following table is taken from the study conducted by TAMPA (2011) to show the increasing production trend of four familiar vegetable products in the region.

Table 4.1: Trend of Area Coverage for Four Vegetables Products

Vegetables	Year		Percentage Increase
	2008/09	2009/10	
Tomato (hectare)	4,454.00	10,841.00	143.4
Onion (hectare)	8,261.00	18,837.00	128.02
Potato (hectare)	2,053.00	2,926.00	42.52
Green pepper (hectare)	5,565.00	9,400.00	68.91
Total (hectare)	20,333.00	42,004.00	106.58

Source: TAMPA, 2011

This trend shows that dramatic alteration is shown year by year and this is expected to continue annually as the region's BoARD is planning to reach the yield per hectare up to 300 quintal per hectare. Besides, both BoARD and TAMPA revealed that vegetable production has introduced at all parts of the region including towns; and the government is working on the issue more

intensively. Hence, the future trend assures that there could be ample vegetable production, which could supply adequate amount of vegetables for vegetable agro-industries.

4.2. Challenges on the Development of Sustainable Vegetable Agro-industries

One aim of this study was to detect the foremost challenges on the development of sustainable vegetable agro-industries in the National Regional State of Tigray. Anchored in this, the detected challenges are presented as follows based on their order of importance:

4.2.1. Challenges on the Supply of Raw Materials

Since the supply of raw materials have direct effect on the development of sustainable vegetable agro-industries, it is necessary to detect the challenges on the supply of raw materials. As a result the challenges detected are presented as follows:

4.2.1.1. Weak Rural Infrastructure

Low level of infrastructure such as substandard storage, inapt packaging and poor transportation lower the quantity and quality of vegetables, which also drops off raw materials supply for vegetable agro-industries (Eric, 2006). Accordingly, the challenges avowed by the key informants are presented as follows:

Poor Transportation

The FGD participants declared that they have a problem on transportation. They transport the vegetable products into the road sides using donkeys and manpower. Similarly, all the interviewed vegetable traders declared that there is transportation problem. These traders said that besides the raising price, the way of transportation is frail and therefore, much amount of vegetables is prone to spoilage during transportation. The vegetable traders also added that some vegetables like onion are transported in bare trucks without packaging as result portions of the vegetable are prone to spoilage. The spoiled products are dropped off together with the unspoiled ones as there is no sorting arrangement during unloading. This causes many products to wreck; as a result, the amount of wastage boosts.

Bezabih and Hadera (2007) noted that most of the rural areas in Ethiopia are not accessible by

vehicle; hence, vegetable products are transported to the road side by low quality transportations such as donkeys, carriage and manpower. This way of transportation requires longer time to reach the market; as a result, the quality of the vegetable products would be affected. Therefore, there is a need of progress in transportation.

Lack of Cold Store Facility

All FGD participants stated that they don't have any cold store on their site. The extension workers supported them in idea about cold store and they have the knowhow. As a result they construct a building for storage but they are unable to install ventilator into the store due to two reasons; first, they don't have the capacity to buy ventilators and second, there is not supply of electric power. Similarly, the vegetable traders informed that there is no cold storage facility for the different vegetables they sale. Three of the interviewed vegetable traders asserted that the municipality of Mekelle city has provided marketing area to them having $60m^2$ volumes, which is going to incorporate cold store facility for vegetables and heating facility for some fruits like banana. These traders said that the land is too small and a portion of it has taken by the municipality for the purpose of road construction. But the municipality of Mekelle city said that the land is enough for vegetable trading considering the high land demand of other industries and the serious land scarcity of the city.

Cold storage is also important for extended storage of vegetables making them conductive for further processing (IBEF, n.d.). In addition to this, Barrie et al (2008) indicated that "the storeroom should be cool and dark with a good ventilation to maintain a flow of air and with protection against insects and rodents" (p.133). Nevertheless, the intended cold store of vegetable traders in Mekelle city is also proposed to have heating facility; however this seems to be unfeasible due to the conflicting conditions of coldness and warmth.

Scarce and Low Quality of Packaging Materials

Both FGD participant vegetable growers and interviewed vegetable traders confirmed that vegetable packaging materials are scarce, costly and of low quality. They forwarded that the cost of sacks, which are common packages for onion and potato, has increased; one sack is currently sold for Birr 13 and even it vanish from market now and again since it is scarce. These

informants also added that the wooden box (gabiya), which is used as a packaging for tomato, is inefficient and has low quality. As a result, breakage of the boxes results in smash up of the product. Similarly, BoARD added that inappropriate handling mechanisms are main challenges which lead to considerable spoilage after harvest

Lack of Supply of Electric Power in Rural Areas

The FGD participants have knowhow about motor pumps. They indicated that it is economical to use motor pumps, which operate by electric power, instead of generators for irrigation. As per the vegetable growers, the oil fuel is costly besides its scarcity and this leads them to interruption of irrigation using generators. They forwarded that motor pumps are more easy to use and are more reliable than generators. However, the lack of supply of electric power limits them from using these motors.

Poor Communication

Some of the FGD participants informed that they don't have mobile phones leading them into communication problems. They are acquainted with the market situations either through their relatives having the access or through arriving into the market place.

Since vegetable agro-industries are export-oriented (Saso, 2010), there should be continues improvement on their performance. One way of achieving competitive edge in the export market is improving the quality of the processed vegetables. This depends on improving quality of raw materials. One way of improving the quality of raw materials is to progress infrastructures like supply of electric power, potable water and communication.

4.2.1.2. Increasing Price and Scarcity of Agricultural Inputs

All participants of FGD stated that the high cost of chemical fertilizers and insecticides, as well as the scarcity of fuel oil (for generators) are the main challenges of the agricultural input side. They declared that the cost of chemical fertilizers and pesticides are overemphasized. Besides, the inputs didn't found on time; as a result the products are prone to spoilage. Similarly, they forwarded that since there is scarcity of fuel oil in the region they are unable to use generators for irrigation. According to the participants, the fuel oil is mostly available for movable vehicles and

they are unable to obtain fuel even if they wait until all vehicles are filled. Service givers are evil to them and usually refused to fill oils for them. Generators are now idle due to this problem. BoARD also stated that limited amount of high yield varieties on the vegetable production sector limited the amount vegetables. Besides, the bureau adds that the amount field spoilage on vegetables is high due to unimproved seed, shortage of water and fertilizers, insect infestation, livestock, and excess rain.

Agricultural inputs are important elements for production and productivity. Scarcity in any one of these inputs could result in diminished quality and quantity of products. Diminished quality and quantity means low productivity of agriculture. According to Leon (n.d.: 4) "low agricultural productivity is the first constraint for agro-industries." Hence, shortage of inputs in the vegetable production could result in low level of vegetable productivity which in turn poses challenge on the development of vegetable agro-industries through laying an obstacle in the form of raw materials scarcity.

4.2.1.3. Seasonality and Perishability of Vegetable Products

BoARD, BoTIUD, TARI, TAMPA, and REST as well as some vegetable traders believed that seasonality and perishability of vegetable products are the main reasons for the backwardness of sustainable vegetable agro-industries development in Tigray. The subsequent tables show the seasonal supply and seasonal area coverage of the three well-known vegetables in the region. Specifically, REST affirmed that it was planned to establish some potato processing plants in the region; however, due to the seasonality supply of potato, it has delayed the plan. REST stated that it is now working on preparing preliminary procedures like cold storage and preservation facilities to assure enduring supply.

One basis of seasonality is farmers have a preference to production of cereal and pulses owing to market and food security concerns (Peter 2004). On the one hand, such preference is right as vegetable production is dependent of climate in Tigray and it is not suitable during the main rainy seasons. On the other hand, this partiality is not correct as farmers require producing cereals and pulses during the winter as well using irrigation. Such preference could damage the availability of vegetables and could pose the most serious challenge, which is deficiency of raw materials for vegetable agro-industries. Similarly, the perishable nature of vegetables causes loss of quality just

after the time of harvest. As a result, high amount of spoilage, which is another challenge on the supply of sufficient raw materials for vegetable agro-industries, is caused. This dissuades investors from investing in the sector.

4.2.1.4. High Post-harvest Lose

BoARD, TARI and TAMPA supposed that the high amount of lose after the harvest of vegetables raises the amount of spoilage, thereby, resulting in low amount of vegetable products that hesitate the continued supply of raw materials for vegetable agro-industries.

As it is forwarded by the above key informants amount of post harvest losses on developing countries like Ethiopia is excessively high which reaches up to 70% in some Sub Saharan countries (UNIDO, 2007; cited in Leon, n.d.). This poses challenge on the development of sustainable vegetable agro-industries through obstructing the amount of raw materials required. As it is put in the literature of this study, high amount of post harvest lose is caused due to surplus supply during peak production seasons, improper handling that result in physical damage, and natural decay. Such lose decreases the quantity of vegetable products. As a result, the raw material requirement of vegetable agro-industries is hindered.

4.2.1.5. Inadequate Skill of Growers

BoARD, TAMPA and REST forwarded that traditional skill of the most part of growers in the region is a major challenge on the vegetable production process and this put an obstacle on the supply of raw materials for vegetable agro-industries. According to BoARD the skill and expertise of growers is low and as a result growers do not know how much fertilizers to utilize on what kind of vegetables, how to handle vegetable products, and how to prolong the shelf life of vegetables.

This results in low quality of vegetables, which are incapable of further processing. Besides, such knowledge problem comes up with the production of slighter amount of vegetables having the consequence of raw materials scarcity, which in turn discourage the development of sustainable vegetable agro-industries.

4.2.2. Challenges on the Investment Area

4.2.2.1. Attitude of Investors

The BoTIUD of Tigray put the lack of accurate decision on the side of some investors as one challenge on the development of sustainable vegetable agro-industries. It declared that four investors have took land from the regional government for the construction of vegetable agro-industries (three tomato sauce, and one tomato juice processors) but not yet started operation. Some of them held off land without any steps forward but do other businesses; and a few erected the building but not starting operation. Some of them even deal with the cement and steel offered to them in a special support for the construction of the industries. As a result, the government has taken actions that range from seizing lands up to arresting illegal investors.

Another reason for the sluggish progress of vegetable agro-industries is the erroneous attitude on investors, which is the need for quick and unfair profit, as per BoTIUD. Most investors think vegetable agro-industries as businesses that do not make money in short period of time. As a result, they have a predilection on dealing with other businesses, which could 'generate high profit' within a bout and have little or no call for vegetable agro-industries. On the other hand, some investors terrify to spend on vegetable agro-industries since they think that there is shortage of raw vegetables in the region. However, the reality is on the other facet in which the BoARD of Tigray stated that the vegetable production and productivity of Tigray is escalating from year to year so that plenty supply of vegetables could be indemnified.

4.2.2.2. Capital Deficiency

Most of vegetable traders as well as vegetable growers put lack of capital as an impediment in the investment of vegetable agro-industries. Similarly, the BoTIUD of Tigray and REST share the same idea wherein most investors lack the capital requirements of vegetable agro-industries. Adding to the doubt in the marketing condition of the industries' output, the need to invest in the sector through credit diluted.

Actually, vegetable agro-industries are kinds of industries that necessitate various machineries and equipments as well as sufficient spare parts for the reason that vegetable agro-industries should not be delayed production waiting for spare parts as this raises the production cost (Peter,

2004; Barrie et al, 2008). So, there must be enough capital to engage in the industries. However, there is capital deficiency in the side of medium and small scale investors which dominate the region.

Other challenges forwarded by all informants in this area include lack of certainty on the marketing of the outputs of vegetable agro-industries, lack of coordination and cooperation and lack of expertise on the area. According to REST, there is not expertise which is specialized on vegetable processing in the region. If there is shortage of expertise on the determination of shelf life, methods of preservation and packaging, and as the knowledge on processing equipments is little (Navindra, 2003), it is not viable to develop sustainable vegetable agro-industries.

4.3. Opportunities on the Development of Sustainable Vegetable Agro-industries

In a similar way, the opportunities identified by this thesis are presented below based on their order of importance.

4.3.1. Favorable Agro-climate

According to BoARD there is high amount of surface and ground water, which has a capacity of irrigating 3000 hectare of land in Tigray. BoTIUD also believed that there is favorable agro-ecological status in the region. TARI also insisted that Tigray has favorable climate for the growth of a variety of vegetables. It believed that Tigray has areas with high production potential that can ensure the sustainable supply of raw materials for vegetable agro-industries. BoARD also put the natural resource conservation, which is recently taken as a culture in Tigray as another opportunity.

The climate of Tigray is portrayed as 39% semi-arid, 49% warm temperate, and 12% temperate with an annual rainfall level of 450-980mm (www.tigraionline.com Retrieved 16/10/2010). The region has two international rivers (Tekeze and Mereb) and many other small rivers like Geba, Worie, Berber, Arqoa etc which are suitable for irrigation (www.tigraionline.com Retrieved 16/10/2010). Consistent with the fact that favorable climate and ample irrigational possibilities make one region possible for the growth of variety of vegetable crops (Rolien and Andre, 2009),

the high amount of water resource contained by Tigray could enhance the vegetable production, which successively grant sustainable supply of raw materials for vegetable agro-industries. In connection with this, the conservation of natural resources could improve the livelihood of rural poor as they depend extremely on natural resources (Melvyn, 2006). Natural resource conservation, specifically soil and water conservation, could improve agricultural productivity including vegetable productivity. This in turn assures sustainable supply of raw materials for vegetable agro-industries. Hence, natural resource conservation is an opportunity for the development of sustainable vegetable agro-industries.

4.3.2. Favorable Policy Environment

Favorable policy environment is the other opportunity stated by all sources. BoARD raised that government commitment in agricultural activities could enhance agricultural productivity, thereby improving production and productivity of vegetables and insuring sustainable supply of raw products. As a result, government commitment on agricultural activities could attract investment in vegetable agro-industries.

The Ethiopian government has put the agro-industry as a necessary sector in the 2002 (1994 E.C.) industrial development strategy (FDRE Industrial Development Strategy, 2002:267). This strategy points out that the agro-industrial sector is a very important sector which adds value to the agricultural products and paves the way to the promotion of SMEs. Besides, the 2010/2011 (2003 E.C.) annual plan of the SMEs Department of the Bureau of Trade, Industry and Urban Development of the National Regional State of Tigray has put the promotion of agro-industries as a key issue in employment creation and income generation. Based on this the Department has planned to develop 26 agro-industry clusters at different places of the Region; of this the two clusters will be vegetable agro-industry clusters. These are; fruit and vegetable processing cluster around Adwa, central zone of Tigray and tomato processing cluster around Wukiro, eastern zone of Tigray (SMEs Department Annual Plan, 2010:44).

More recently, the Ethiopian government has prepared a medium term strategic framework for the next five years. This framework, which is known as the Growth and Transformation Plan (GTP), has dedicated to improve the productivity of agriculture through taking different agro-ecological zones into account, focusing on specialization and diversification, and strengthening

agricultural marketing (MoFED, 2010). Based on this, GTP has planned to reach the productivity of root crops from 44 quintal per hectare in 2009/10 to 50, 55, 62, 70, and 78 quintal per hectare in 2010/11, 2011/12, 2012/13, 2013/14, and 2014/15 respectively; and the productivity of fruits and vegetables will grow from 84 quintal per hectare in 2009/10 to 96, 110, 126, 144, and 165 quintal per hectare in 2010/11, 2011/12, 2012/13, 2013/14, and 2014/15 respectively (MoFED, 2010). In a similar way, the Regional Government's GTP has give emphasis for the irrigational activities in which, the current (2010/2011) 83,000 ha irrigated land will be grow into 350,000 ha in the years to come and the productivity of vegetables will be grow from 300 quintals per hectare in 2009/10 into 440 quintals per hectare within the next five years (BoFED, 2010). These trends show that both federal and Regional Governments have devoted to increase the agricultural productivity, thereby, the vegetable productivity, which is an opportunity for the development of vegetable agro-industries in a sustainable way.

Similarly, GTP has given the industry sector an extreme prominence through the way of encouraging export based and import substitution industries (MoFED, 2010). The plan has given strategic focus on industries which are labor intensive and having wide market, use agricultural products as input, export oriented and import substituting, and contribute for faster technology transfer (MoFED, 2010). Subsequently, agro-industries are among the eight industries which will receive special support during the plan periods (Textile and Apparel, Leather and Leather Products, Sugar and Related Industries, Cement, Metal and Engineering, Chemical, Pharmaceutical, and Agro-industries) (MoFED, 2010). This is an exceptional opportunity on the development of sustainable vegetable agro-industries. Even though there is not documented literature on the marketing of processed vegetables in Tigray, it is estimated that there is good market for the products.

4.3.3. Institutional Support

Another opportunity stated by some of the participants (TARI and TAMPA) is the support offered by them to enhance the production capacity and give surety for the sustainable supply of vegetables. TARI retorted that it is mandated for technology generation and it is working on improving the production and productivity of vegetable crops through testing of new varieties for their adaptabilities in different agro-ecologies of the Tigray, disseminating the proven ones as

well as strengthening the market chains of vegetable crops. It assured that all its efforts are toward increasing overall production and productivity of all agricultural commodities among which vegetable crops are the most important cash crops that should be offer emphasis. To realize such vision TARI, especially the Mekelle Agricultural Research Center (MARC) which is covering about 13 weredas of the eastern and south-eastern zones of the region is undertaking adaptation trials on a number of vegetable crops and some of them are on pipeline for releasing. For illustration, it has released some varieties of tomato which have longer shelf life and there are also some efforts to introduce improved storage structures for perishable vegetables such as potato, tomato and onion. TARI also forwarded that the existence of vegetable agro-industries will depend on the availability of sufficient vegetable products and sufficient products to be supplied to these agro-industries will also be dependent on the availability of proven technologies like varieties, agronomic practices, and market oriented production systems. TARI is working to see all these happening at the ground. Such supports, according to TARI, increase production and productivity of vegetable crops and this attract investors and vegetable growers to take on vegetable agro-industries.

In a similar way, TAMPA affirmed that it contribute to the development of sustainable vegetable agro-industries through the introduction of different technologies like cold storage, awareness creation and training vegetable growers, and promotion services for investors in other regions. TAMPA clarifies that it has introduced cold storage facility in some selected areas of the region and it has given training for growers concerning contract farming, quality control and marketing linkages. It has also promoted the vegetable status of Tigray for the investors at Mojo. TAMPA dictated that all these supports are opportunities for the development of sustainable vegetable agro-industries.

There must be short term cold storage facilities in which, vegetables could be maintained at growers level using local technologies; and the long term that needs modern cold storage technologies at industry level (Mujibur, n.d.). Therefore, the technology promotion activities, awareness creation and skill development of growers as well as the promotion services carried out by TAMPA have fine results on the introduction of modern supply chain and effective vegetable agro-industries. Similarly, REST pointed up the supports it made as provision of improved and new varieties of vegetable seeds; technical support and training to farmers,

development agents and experts at all level; provision of different water harvesting techniques; installation and assembling of small scale processors like potato chips machine; and provision of bio and organic liquid fertilizers to improve soil fertility. On the other hand, BoTIUD alleged that there is enforcement like the 30:70 credit access in collaboration with the Dedebit Micro-finance. This means that BoTIUD facilitates a 70% credit for any investor with a capital of 30% given that the investor wants to involve in developmental industries like the vegetable agro-industries. Another contribution by BoTIUD for the development of vegetable agro-industries is hiring senior irrigation experts at regional level and abetting irrigational activities.

These activities of TARI, TAMPA and REST could support the development of vegetable agro-industries through maintaining the ongoing increase of vegetable production and productivity and attesting the fact of sustainable supply of vegetable products for vegetable agro-industries. According to Johnson et al (2008):

> In optimizing resources for extension, issues include whether agricultural extension and agricultural research and development are the responsibility of different government departments (separation hinders effectiveness), the extent to which government agencies, the rural and urban marketing sectors, and private industry interact. In general, the better the degree and extent of linkage and liaison between research, development, and extension, the better the results. (p. 48)

In recent times, it has recognized that the linkage sandwiched between the farm and nonfarm sectors ensure the availability of raw material both qualitatively and quantitatively at a reasonable price is very important (Subrahmanyam, 2000). Hence, TARI and TAMPA have started the task of vegetable production and productivity increment which could attract investors and strengthen the linkage among growers and processors, which is the main ingredient on the development of vegetable agro-industries. Similarly, as production of vegetables increase continually, there will be overproduction that could result in decrease in prices and grower's incomes which in turn cause grower themselves or their cooperatives to opt for processing (Navindra, 2003). Therefore, sustainable increase of vegetable production results in either attracting investors or swaying growers to vegetable agro-industries.

4.3.4. Economic Growth and Spreading SMEs

TAMPA put the economic growth and its result in per capita income growth and the flourishing of SMEs as the main opportunities for the development of sustainable vegetable agro-industries.

According to Meeta (2007)

> Like the emerging situation in several developing countries changes in the socio economic environment is leading to higher demand for processed foods. This change is characterized by urbanization, higher incomes, less time available for cooking, increasing globalization and exposure to global markets, increasing number of nuclear families. There is higher acceptance of processed food because of higher consumer awareness about nutritional aspects. There is rising demand for ready-to-cook and ready-to-eat convenience foods. 'Demonstration effect' through explosion in information and communication technologies is creating a new demand for western type foods. (p. 7)

The economy of Ethiopia is growing in the last five years at an average rate of 11% with agriculture and allied activities 8%, industry 10% and service 14%. This results in 8.4% growth of the average annual per capita income. This trend is expected to increase in the next five years with the target of 11.03%, 11.13%, 11.27%, 11.22% and 11.4% growth rate of real GDP within 2010/11, 2011/12, 2012/13, 2013/14, and 2014/15 respectively (MoFED, 2010). This economic growth opens a room for the consumption of processed food products (UNIDO, IFAD, and FAO, 2008), which opens a room for the expansion of vegetable agro-industries.

Similarly, the economy of Tigray is growing in the last years; particularly from 2006/07 to 2009/10, GDP has shown an average increase of 11.7% (BoFED, 2010). Agriculture was grown at an average rate of 9.8%, industry at 10.6% and service at 14.1%. The per capita income of the region is also growing from Birr 1361.0 in 2006/07 to Birr 1927.2 in 2009/10. The proportion of people under severe poverty (with an income of under $ 1 daily) has decreased from 38.7% in 2006/07 to 32.8% in 2009/10 and is planned to decrease into 23.8% in 2014/15. The amount of urban unemployment has also fallen from 28.8% in 2006/07 to 19% in 2009/10 and is expected to drop into 13% in 2014/15 (BoFED, 2010).

When we come to the opportunity related with the promotion of SMEs, promoting such kinds of enterprises pave the way for the development of vegetable processing SMEs. SMEs development in vegetable agro-industries could be profitable given that good quality of processing products, attractive packaging, and well-managed business could be achieved by the SMEs (Peter, 2004). The number of SMEs has increased from 49,392 in 2006/07 to 106,745 in 2009/10; as a result, the region has created employment for 193,286 people within these years. This is intended to rise into 416,373 in the next five years (BoFED, 2010). The flourishing of SMEs replicates shorter supply chain from the farm into market and flexible firms that quickly act in response to changing consumer needs (Maureen, 2010). Therefore, the promotion of SMEs is an opportunity for the development of vegetable agro-industries.

4.3.5. Increasing Vegetable Production

All FGD participants stated that improved seed is supplied by the agriculture offices and cooperatives. Loan is also provided by different agents including REST and Dedebit Microfinance. Besides, continual help and training is provided by the extension workers. They also put the roads constructed by government decrease their trip. As a result the production and productivity capacity of their area is increasing from time to time. Similarly, all of the vegetable traders agreed on this idea. They explored this fact through explaining that before certain time they were forced to import vegetables from other regions mainly from Woreta and other parts of the Amhara region as vegetable production was interrupted in Tigray. Nevertheless, in recent times the level of vegetable production has increased and most of the vegetables they sale are growing in Tigray. As it is presented in section 4.1, the production and productivity of Tigray is in an ongoing increase and this is an opportunity on the development of sustainable vegetable agro-industries.

4.3.6. Increasing Marketing Opportunities

Most of the interviewed supermarkets and eateries approved that the demand for processed vegetables, particularly for the most common tomato sauces, has increased from time to time. The supermarkets put that the increasing number of institutions such as hospitals, universities, military camps as well as children and elder camps leads to the increase in demand for tomato sauce. Similarly, most of the eateries agreed that since the number of customers has increased

from time to time, they obliged to utilize processed tomatoes as it is more convenient and time saving. Both informants concluded that there could be higher demand even for other processed vegetables if they were in the market. This fact shows that there is high demand for processed vegetables in the region.

4.4. Sustainable Development of Vegetable Agro-industries in Tigray

Vegetable agro-industries could be developed in a sustainable way through two things; ensuring sustainable supply of vegetable products (Subrahmanyam, 2000) and maintaining large market share on the local and domestic markets (Barrie et al, 2008). Sustainable supply of raw materials could be certain by applying either contact farming or captive farming (Subrahmanyam, 2000). Similarly, high amount of market share could be maintained by conducting feasibility study, selecting the right product, developing marketing and selling strategy, and customer care (Barrie et al, 2008).

4.4.1. Improvements on the Supply Chain

The participants of the FGD recommended that government has to pay attention on providing of supply of electric power for the rural areas so that they could introduce motor pumps, ventilators and other required technologies; government has to finance portion of the cost required to install transformers with cooperatives also share the other portion; and government has to introduce special facilities purposely prepared for the safe transporting, packaging and handling of vegetable products. Additionally, they revealed that government has to provide them with marketing place in the town for the intension of supplying products for their customers in modern features.

Similarly, BoARD dictated that the main activities that should be taken in ensuring the sustainable vegetable agro-industries development is enhancing the vegetable production through specialization of farm works, strengthening of three-round production, shifting rain fed crops (from cereals to vegetables) in selected areas, enhancing farmer skills, utilizing different input technologies, and increasing the intensity and frequency of production. According to TARI, sustainable development of vegetable agro-industries could be ensured through investigating the potential vegetable producing areas and closely working with research extension as well as the

farming community. TAMPA believes that the present volume per quantity and quality ratio of production must increase and production cost must decrease in order to develop sustainable vegetable agro-industries in Tigray.

The increase in quantity and quality of raw materials (Mubarik, n.d.) could come up with plenty supply of raw materials, which attract investors to involve in vegetable agro-industries. Therefore, there is a need for managing the risks arising from low level supply of raw materials, which requires an effort on the supply chain like managing irrigation and other agricultural inputs. These activities augment production and productivity thereby guaranteeing sustainable supply of vegetable products for vegetable agro-industries. As it was provided in the literature review part of this paper, sustainable delivery of raw materials from the supply chain could be ensured through the use of such methods like contact farming and captive farming (Subrahmanyam, 2000). Through contract farming vegetable agro-industries could implement contractual agreements with potential vegetable growers to ensure sustainable supply of raw materials for their operation (Flavia, 2001). Similarly, vegetable agro-industries could grow raw materials through acquiring or leasing land making them independent of other growers through the use of captive farming (Subrahmanyam, 2000).

4.4.2. Insuring Sustainable Market

All key informants underlined that the obtaining of market is the main issue for the sustainability of vegetable agro-industries. TAMPA suggested the uninterrupted advertisement and promotion of processed vegetables create sympathetic on the side of the society. REST also advocated that vast efforts are required on deterring the patterns of eating in the region wherein the society has to practice eating processed vegetables. According to REST this needs heavy promotional works.

4.4.3. Other Ways

One of the key informants, TAMPA, forwarded that training and promotion services must be reinforced for investors and credit facilities has to be provided for them in order to engage in vegetable agro-industries. This is good notification because skill and know-how upgrading (Navindra, 2003) could realize the sustainable development of vegetable agro-industry by ensuring plentiful supply of raw materials and convincing investors about the prosperity of the

sector. Low access to credit influence the development of agro-industries (Leon, n.d.). Therefore, facilitating credit for small and medium level investors could also enforce investors and accelerate the development of sustainable vegetable agro-industries.

Similarly, REST situated the way of developing sustainable vegetable agro-industries as follows. First, develop the capacity of growers, experts and other agricultural agents; then, skill up the highly productive varieties of vegetable seeds; after that, make exposure visit on best practices and expand best practices; next, enhance production and productivity and develop post harvest storage to improve shelf life; then develop and arrange marketing and promotion for processed vegetables; lastly, assemble vegetable agro-industries.

Narin and Shamsul (n.d.: 84-86) provided similar stages, in which, promoting any agro-industry should progress through; framing national policy on agro-industry development, setting up an organization to work for agro-industry, setting up a national committee on agro-industry development, solving the problem of raw materials, creating well-trained human resource for agro-industry development, increasing fund for research and development, developing proper intermediate technology, increasing local production of food-processing equipment, encouraging more investment in agro-industry and channeling soft-loan for agro-industry.

4.5. Summary

Generally, the challenges and opportunities as well as the sustainable development of vegetable agro-industries forwarded by the different key informants can be summarized as:

4.5.1. Challenges

1. Challenges on the supply of raw materials like increasing price and scarcity of agricultural inputs; weak rural infrastructure like poor transportation, lack of cold storage, scarce and low quality of packaging materials, lack of electric power and poor communication; inadequate skill of growers; seasonality and perishability of vegetable products; and high post harvest loses.

2. Challenges on the investment area which are low attitude of investors, capital deficiency, lack of certainty on market, lack of coordination and cooperation as well as lack of technical expertise.

4.5.2. Opportunities

1. The ongoing increase in vegetable production, which could guarantee sustainable supply of vegetables for vegetable agro-industries

2. Favorable agro-climatic condition such that Tigray has a capacity of irrigating 3000 hectare of land and suitable climatic condition to grow different vegetables, which could also guarantee sustainable supply of raw materials for vegetable agro-industries.

3. Government policies and strategies that favor the development of sustainable vegetable agro-industries.

4. Institutional support wherein different institutions like BoARD, BoTIUD, TARI, TAMPA and REST are working on the enhancement of vegetable production and introducing of vegetable agro-industries.

5. Economic growth and the flourishing of SMEs, which result in an increase in the individual per capita income, urbanization, and create marketing opportunity for processed vegetables since there is less time for cooking.

4.5.2. Ways of Developing Sustainable Vegetable Agro-industries

1. Farm works specialization and strengthening three-round production so as increase the availability of raw materials;

2. Insuring sustainable market for the outputs of vegetable agro-industries;

3. Reinforcing training and promotion services for investors, and

4. The provision and facilitating of credit for investors as well as growers.

CHAPTER-V

CONCLUSIONS AND RECOMMENDATIONS

This chapter consists of some conclusions drawn from the study plus recommendations provided for the purpose of interventions that supplement the development of sustainable vegetable agro-industries in the National Regional State of Tigray.

5.1. Conclusions

Considerable changes have been registered in the last five to six years on the production and productivity of vegetable products in the National Regional State of Tigray on account of the attention given to the sector by the federal and regional governments and the awareness of farmers valuing the products as commercialization products. The trend on vegetable production reveals that there is an increase both in the area coverage and level of yield per hectare in the last years and this is expected to continue in the next years as well. This ongoing increase could ultimately lead to complexity in the supply and marketing chains and opens room for a great deal of spoilage due to market saturation. As a result, vegetable growers experience loses discouraging them for further growing of the items. Owing to the high nutritional value of vegetables, however, growers have to encourage producing vegetables by forming justifiable market for their products. In so doing, one has to think of value adding techniques so as to increase the products' shelf life and keep on them marketable. For this reason, the need for vegetable agro-industries arises. Vegetable agro-industries not only increase the shelf life of vegetable products but also transform them into more convenience forms as well as internationalize the products opening room for exportation.

The development of sustainable vegetable agro-industries heavily depends on the availability of vegetable products. Vegetables produced in the National Regional State of Tigray include onion, tomato, green pepper and lettuce. Amount of vegetables produced for sale within the local market is estimated to be 90% of the overall vegetables growing in the region and the rest 10% is remained at home for family consumption. The total trend on vegetable production of the region shows that there is dramatic increase from year to year and this is expected to continue in the next

years as well; and this could attract some vegetable agro-industries. However, further work is required in providing the necessary agricultural inputs and improving the agricultural infrastructure like cold storage and packaging facility, rural road construction, rural electrification and communication as well as advancements on the irrigational schemes in order to increase the production and productivity more intensively and attract more vegetable agro-industries.

The aim of this thesis was to detect the key challenges and opportunities on the development of sustainable vegetable agro-industries in the National Regional State of Tigray. As a result, some challenges have detected on both the supply of raw materials and the side of the investment area. Some of the challenges on the supply of raw materials include the increasing price and scarcity of raw materials, weak rural infrastructure, inadequate skill of growers, and seasonality and perishability of vegetable products. Some of the challenges on the investment area are low attitude of investors, shortage of capital and lack of certainty on the market of the vegetable agro-industry products. The thesis has also identified opportunities like favorable climate, favorable policy, encouraging institutional support, continuing increase on the production of vegetable products and the economic growth of the whole country.

As it is stated above, vegetable agro-industries are highly dependent on domestic production and supply of vegetable products. Such industries could be developed in a sustainable way through ensuring sustainable supply of vegetable products and maintaining large market share on the local and foreign markets. Sustainable supply of raw materials could be certain by applying either contact farming or captive farming. Therefore, vegetable agro-industries rely on arrangements with vegetable growers that supply raw materials for them. The industries could engage in contract farming, which is an efficient mechanism that regulates the production and supply of raw materials through contractual agreements among vegetable growers and vegetable agro-industries. Vegetable agro-industries could also experience captive farming wherein they produce their own raw materials and ensure sustainable supply by themselves. In any case, there should be cooling and storing facilities within the production sector to increase the shelf life of vegetable products and insure sustainable supply of vegetables for the vegetable agro-industries and vegetable production should be carried out in such a way that accomplishes the quality and quantity requirements of vegetable agro-industries. Besides, vegetable agro-industries should hold the great portion of the internal and external markets to ensure their sustainability.

5.2. Recommendations

Based on the results and findings of this study, the following recommendations are given so as to be considered in future intervention strategies which are aimed at the development of sustainable vegetable agro-industries in Tigray.

- Vegetable production and productivity has to keep on increasing in intensified and diversified way through up grading the provision of different agricultural inputs. Besides, there should be strict activity on detecting areas of specialization for vegetable production considering the climate and different agro-ecological zones of the region. This could satisfy the wide range of raw materials requirement by vegetable agro-industries and could draw advantage for vegetable growers, investors as well as the whole society.

- According to Mujibur (n.d.), "development of adequate infrastructure for transportation of raw materials and finished goods from the production centers to processors and from there to the market –both domestic and foreign" (p. 98) is a recommended action that should be undertaken to facilitate the development of sustainable vegetable agro-industries. Therefore, government has to advance the poor level of transportation, especially at the potential vegetable growing areas for safe and quick transportation of raw materials. Besides, the technology of refrigerated transport has to be introduced in order to sustain the quality of vegetable products until they reach into vegetable agro-industries.

- The technology of cold storage facilities has to be introduced at growers' level to overcome the main challenges on the development of vegetable agro-industries, which is seasonality of raw vegetables. Small, medium, as well as large stores having ventilators should be constructed in the specialized vegetable growing areas depending up on the level of production. This enables growers to stock up their products on mass basis and insure sustainable supply throughout the year. As a result, vegetable agro-industries could be emerged attracting by the availability of raw materials.

- There should be enhancement on the packaging materials of vegetables. The current packaging materials of wooden boxes and sacks have to be replaced by packaging materials having enough strength, convenience on using and suitable size like plastic

boxes. Similarly, the primary and secondary packaging technique has to be introduced. This lessens the amount of wastage caused due to improper packaging and insures safe supply of raw materials for vegetable agro-industries.

- Government has to facilitate the program designed for supplying electric power for all rural centers in the next years so that the agricultural sector could be modernized through the introduction of motor pumps for irrigation, ventilators for cold storage, and other facilities that enhance production and cope up with seasonal supply of vegetable products, which in turn attracts vegetable agro-industries.

- Training and workshop sessions on pre and post harvest handling has to be given for vegetable growers as well as extension workers for the purpose of improving the shelf life and decreasing the spoilage amount of vegetable products so that sustainable supply of vegetable products could be assured.

- Purposive training has to be provided by the government and other development bodies for investors regarding the importance of vegetable agro-industries, the role they played on the transformation of agriculture, their part in employment creation, as well as their profitability and exportability. This is required in order to bring attitudinal change on the side of investors, who think vegetable agro-industries as slow profit generator businesses, could create knowhow on the investment area and initiate investors to engage in the sector.

- There should be arrangements by the private and public credit institutions in providing easy access to credit for those who have interest to take on vegetable agro-industries through facilitating quick credit access and introducing special incentives like decrement or exemption of interest rates and long term loans. In connection to this, government has to encourage investment in the sector through more incentives such as relax tax and duty on imported equipments, besides facilitating credit. Even though government has used to do this incentive for other sectors, the vegetable agro-industry sector has to get focus too.

- It has put in the GTP that the development of agro-industries is one of the eight sectors that will receive special support. As a result, the sector is expected to get all the necessary supports from the side of the government. For better progress of agro-industries, however,

an agro-industry development division, particularly vegetable agro-industry development division, should be established within the major governmental stakeholders such as the BoARD, BoTIUD, TAMPA and TARI. The establishment of this division could harmonize the development of the sector with the ongoing development of vegetable production.

- There should be well trained human resource that could serve the sector intellectually and technically. The government has to initiate the state and privately owned universities in the region to design training courses on vegetable processing technology and produce graduates trained in the technology.

- The development of vegetable agro-industries has to be in a sustainable way through insuring sufficient supply of raw materials by applying one of the three methods of backward linkages; which are contact farming, captive farming and cooperative farming; as well as through promoting market for the outputs. This could offer permanent employment on the part of the society, income tax for government and profit for the business owners whatever they may be.

- Vegetable agro-industries development should be environmental friendly. As the industries are intended, there should be training on type of energy supply to be utilized by the project, waste and water management techniques, and other environmental concerns.

- Government should be realized the sustainable development of vegetable agro-industries through appropriate utilization of the opportunities on hand and coping up with the challenges.

- Lastly, further research has to be conducted in detail on the development of vegetable agro-industries by other researchers and the governmental and non governmental institutions in the region, especially research institutions like Mekelle University, should allocate funds to grant these researches.

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APPENDICES

Appendix-1 English Interview Schedule

Mekelle University

College of Business and Economics

Department of Management

Graduate Program-Development study

Interview Developed for the Study of "Identifying Challenges and Opportunities on the Development of Sustainable Vegetable Agro-industries"

Part I: Introduction

Dear respondents, first of all I would like to thank you in advance for your willingness for this interview. The purpose of this interview is to collect data relevant to the study "challenges and opportunities on the development of sustainable vegetable agro-industries in the National Regional State of Tigray". With the intention of identifying the main challenges and opportunities of developing sustainable vegetable agro-industries in the Region, it has become necessary to gather the views of different respondents regarding the issue. Based on this fact, you are required to assist the study through giving the correct response for the questions provided. Your responses will be kept confidential. Thank you for sharing your golden time.

Part II: Interview Questions for the Bureau of Agriculture and Rural Development of Tigray

Date _____

1. Do you think that the current production of vegetables in Tigray could meet the high amount requirement of raw material by vegetable agro-industries?

2. What challenges do the existing vegetable production practices have?

3. What are the opportunities on the existing vegetable production practices?

4. What measures should be taken to enhance vegetable production in a sustainable way in Tigray?

Part III: Interview Questions for the Bureau of Trade and Industry of Tigray

Date _____

1. There are not vegetable agro-industries in Tigray. What are the challenges?

2. Are there opportunities for the development vegetable agro-industries? What are these opportunities?

3. Is there any support made by the Bureau of Trade and Industry to develop sustainable vegetable agro-industries in Tigray? Please explain it if there is any support?

Part IV: Interview Questions for Tigray Agricultural Research Institution/TARI

Date _____

1. Does TARI support the development of vegetable agro-industry in the National Regional State of Tigray? If it supports how?

2. Does TARI have a plan to increase vegetable production in Tigray? How is it going to implement the plan?

3. What implications will the increase in vegetable products has on the development of vegetable agro-industries?

4. What supports are made by TARI to decrease the post harvest loses of vegetable products?

5. What are the main challenges on the development of sustainable vegetable agro-industries?

6. How can sustainable vegetable agro-industries develop in Tigray according to TARI?

Part V: Interview Questions for Tigray Agricultural Marketing Promotion Agency /TAMPA

Date _____

1. What are the challenges on the marketing of vegetable products which have direct contact with the lack of vegetable agro-industries?
2. Are there opportunities that encourage the development of sustainable vegetable agro-industries? If yes what are they?
3. Does TAMPA support the development of vegetable agro-industries? If it does in what way?
4. How can sustainable vegetable agro-industries develop in Tigray according to TAMPA?

Part VI: Interview Questions for Relief Society of Tigray /REST

Date _____

1. What activities are implemented by REST to support the development of sustainable vegetable agro-industries in Tigray?
2. Are there challenges on the development of sustainable vegetable agro-industries in Tigray? If so, what are they?
3. Are there opportunities for the development of sustainable vegetable agro-industries in Tigray? If yes, what are these opportunities?
4. How could sustainable vegetable agro-industries developed in Tigray according to REST?

Part VII: Interview Questions for Fresh Vegetable Traders

Date _____

1. What kinds of vegetables do you trade?

   • Tomato • Onion • Cabbage • Swiss chard • Beet root

   • Potato • Hot pepper • Carrot • Lettuce • Garlic

2. From where do you bring these vegetables?

   • From large land holders/producers • From vegetable cooperatives

   • From small land holders/ producers • From other traders • Others

3. Who are your customers?

   • Business/ Hotels, Restaurants, Cafeterias etc • Retailers

   • Government institutions/ Universities, Military, etc • Households

   • Others

4. What challenges do you face on the supply of the vegetable products? Which of them is the most critical?

   • Seasonality of vegetable products • Perishable nature of raw materials

   • High quality of vegetable products • High cost/ low quality of transport

   • Low quality of packaging • Lack of quality storage

   • Others

5. What are the opportunities on the supply of vegetable products? Rank them according to their importance.

   • Increasing amount of vegetable products

- Increasing quality of vegetable products
- Others

6. How do you evaluate the demand for vegetable products?

   - It is increasing
   - It is not changed
   - It is decreasing

7. Why don't you invest either cooperatively or privately on vegetable agro-industry?

   - Lack of capital
   - Uncertainty on the supply of raw materials
   - Lack of know how
   - Uncertainty on the marketing of the outputs
   - The fear for high competition
   - Others

Part VIII: Interview Questions for Super Markets

Date _____

1. What kinds of canned vegetables do you sell?
2. From where do you bring these products?
3. How do you evaluate the demand for these products?

   - It is increasing
   - It is not changed
   - It is decreasing

4. Who are the consumers of the products?

   - Business/ Hotels, Restaurants, Cafeterias etc
   - Retailers
   - Government institutions/ Universities, Military, etc
   - Households
   - Others

5. What challenges do you face during selling such products? And their solutions?

6. If such products begin to be produced in Tigray, are you going to buy and distribute them? Why and why not?

Part IX: Interview Questions for Eateries

Date _____

1. Do you use canned tomatoes?

2. If you use, how much do you use per day?

3. What about fresh tomatoes?

4. How many fresh tomatoes do you use per day?

5. Which one do you consume frequently? Fresh or canned tomatoes? Why?

6. Are you going to buy the products if canned tomatoes begin to be produced in Tigray? Why?

7. Does the marketing process of other vegetable products have problems? If it has what are they?

Appendix-2 Checklist for FGD:

- ✓ Amount and types of vegetables they produce and for what purpose
- ✓ Opportunities of the production process
  - Availability of improved seed
  - Availability of different water harvesting technologies
  - Supply of fertilizers (both compost and chemical)
  - Technical support by experts
  - Others
- ✓ Challenges of the production process
  - Field spoilage
  - Natural disaster (shortage of rainfall, insects and pests)
  - Storage and packaging
  - Others
- ✓ Opportunities on marketing the products
  - Demand
  - Price
  - Others
- ✓ Challenges on marketing the products
  - Packaging
  - Transportation
  - Price
  - Others
- ✓ Cooperate and start vegetable agro-industries which means processing of some vegetable types like tomato and potato as well as refrigerated storage, packaging, and transportation of other types like onion, garlic, cabbage, Swiss, lettuce, beet root, carrot, hot pepper etc
  - What are the problems
  - What should be done do you say

Appendix -3 Tigrigna Interview Schedule

ዩኒቨርስቲ መቐለ
ኮሌጅ ቢዝነስን ኢኮኖሚክስን
ማናጅመንት ዲፓርትመንት
ፕሮግራም ድሕረ ምረቃ መፅናዕቲ ልምዓት

"ኣብ ክልል ትግራይ ቀፃልነት ዘለዎም ናይ ኣሕምልቲ ኣግሮ-ኢንዳስትሪ ኣብ ምልማዕ ዘለዉ ማሕልኾታትን ፀጋታትን" ንዝብል መፅናዕቲ ዝተዳለወ ቃለ-መሕተት

1.<u>መእተዊ</u>

ዝኸበርኩም ተሓተትቲ! ብመጀመርያ ነዚ ቃለ-መሕትት ንምምላስ ፍቃደኛታት ኮይንኩም ብምርካብኩም ኣዝየ የመስግነኩም። ቀንዲ ዕላማ እዚ መፅናዕቲ'ዚ ኣብ ክልል ትግራይ ቀፃልነት ዘለዎም ናይ ኣሕምልቲ ኣግሮ ኢንዳስትሪ ማለት' ውን መዐሽጊ ፋብሪካታትን ዘመናዊ መኽዘናትን ኣብ ምልማዕ ዘለዉ ማሕልኾታትን ፀጋታትን ንምምማይን ጠቀምቲ ሓሳባት ንምሃብን እዩ። በዚ መሰረት ንሶም/ን ወርቃዊ ጊዜ ብምውፋይ ነቲ መፅናዕቲ ዘድልዩ ትኽክለኛ ዝኾነ ሓበሬታት ንክህቡ እንትጥይቅ እቲ ዝህብዎ ምላሽ ሚስጥራዊ ከም ዝኸውን ብምርግጋፅ እዩ።

2.ንነጋዶ ኣሕምልቲ ዝተዳለወ ቃለ-መሕትት

□እንታይን እንታይን ዓይነት ኣሕምልቲ ትሸጡ?

□ካበይ ተምፅእዎም?
□ተጠቀምቲ እዞም ፍርያት እኒ መን እዮም?
□ኣብ ከይዲ ዕዳጋ ዘጋጥምኹም ማሕልኾታት እንታይን እንታይን እዮም? ካብዚኣቶም እቶም ቀንዲ ቀንዲ ዝበሃሉ ግለፅዎም?
□ኣብ ከይዲ ዕዳጋ ኣለዉ ትብልዎም ፀጋታት እንታይን እንታይን እዮም? ካብዚኣቶም እቶም

ዝበለፁ ፀጋታት ግለፅዎም?

□ብግሊ ኮነ ብውዳበ ናብ ዘመናዊ ዝኾነ ኣግሮ ኢንዳስትሪ ኣሕምልቲ ዘይኣተኸምሉ ምኽንያት እንታይ እዩ?

3.ንስፖርሪ ማርኬታት ዝተዳለወ ቃለ-መሕትት

□ትሸጥዎም ዓይነት ዕሹጋት ኣሕምልቲ ይግለፁለይ?

□ነዞም ዕሹጋት ኣሕምልቲ ካበይ ተምፅዎም?

□እቶም ዕሹጋት ኣሕምልቲ ፅቡቅ ዕዳጋ ዶ ኣለዎም?

□ናይዞም ዕሹጋት ኣሕምልቲ ተጠቀምቲ እኒ መን እዮም?

□ኣብ ከይዲ ዕዳጋ እዞም ኣሕምልቲ ዘጋጥምኹም ማሕልኾታት ኣለዉ ዶ? እንተሃልዮም እንታይን እንታይን እዮም?

□ኣብ ከይዲ ዕዳጋ እዞም ኣሕምልቲ ዘጋጥምኹም ኣለዉ ትብልዎም ፀጋታት እንታይን እንታይን እዮም?

□ኣብ ትግራይ ከምዚኦም ዓይነት ፍርያት ዘፍሪ ፋብሪካ እንተዝህሉ ዓማዊል ምኾንኩም ዶ? ከመይ የብርሁለይ?

4.ንዓማዊል (ሆቴላት፣ ካፌ፣) ዝተዳለወ ቃለ-መሕትት

□ዕሹጋት ኣሕምልቲ ትጥቀሙ ዶ?

□ተጠቀምቲ እንተኾንኩም ኣብ መዓልቲ ክንደይ ዝኣክል ትጥቀሙ?

□ብዝበዝሐ መጠን ትጥቀምዎ ዝተዓሸገ ድዩስ ፍሬሽ? ንምንታይ?

□ኣብ ትግራይ ከምዚኦም ዓይነት ፍርያት ዘፍሪ ፋብሪካ እንተዝህሉ ተጠቀምቲ ምኾንኩም ዶ? ከመይ የብርሁለይ?

Appendix-4 Tigrigna FGD Checklist

- መጠንን ዓይነትን ፍርያት፣ ንምንታይ ምኽንያት
- ኣብ ምፍራይ ኣሕምልቲ ዘለው ፀጋታት
  - ቀረብ ምሩፅ ዘርኢ
  - ቀረብ ቴክኖሎጂ ማይ
  - ቀረብ መዳበርያ
  - ሓገዝ ሰራሕተኛታት ኤክስተንሽን
  - ካልኦት
- ኣብ ምፍራይ ኣሕምልቲ ዘለው ማሕልኾታት
  - ብልሽት ፍርያት ኣብ መሬት
  - ተፈጥራዊ ሃልኪታት
  - ፀገም መኽዝንን መትሓዚታትን
  - ካልኦት
- ኣብ ዕዳጋ ዘለው ፀጋታት
  - ድሌት ሕ/ሰብ
  - ምውሳኽ ዋጋ ፍርያት
  - ካልኦት
- ኣብ ዕዳጋ ዘለው ማሕልኾታት
  - ፀገም መትሓዚ
  - ፀገም መጓዓዝያ
  - ምውዳቅ ዋጋ ፍርያት
  - ካልኦት
- ተጎጂልኩም ኮነ ብግሊ ናብ ኣግሮ ኢንዳስትሪ (ማለት ውን ዝሑል መኽዘን መትሓዚን መጓዓዝን ሽጉርቲ ፣ ፃዕዳ ሽጉርቲ ፣ሓምሊ፣ ቆስጣን ወዘተ) ዘይኣተኹምሉ ምኽንያት

Appendix-5 Key Informants Status

Table A.1: Name and authority of the officials participated in the interview

S/N	Name of the Office	Interviewee	Authority	Date of interview
1	Bureau of Agriculture and Rural Development of Tigray	Ato Fisseha Yaye	Chief Vegetable Expert	06/05/2011
2	Bureau of Trade and Industry of Tigray	Ato Atakilti Hailemariam	Socio-economic Research Expert	04/05/2011
3	Tigray Agricultural Research Institute	Ato Hailessilasie Amare	From Vegetable Research Sector	06/05/2011
4	Tigray Agricultural Marketing Promotion Agency	Ato Tsehaye -	From Agro-processing Sector	04/05/2011
5	Relief Society of Tigray	Ato Tadesse Gebrehiwot	From Agro-processing Development Sector	04/05/2011

Table A.2: Name and address of vegetable growers participated in the interview

S/N	Name of the FGD Participants	Occupation	Address	Date of interview
1	Ato Fisume Libelo	Farmer	Gereb Giba	12/04/2011
2	Ato Gebremariam Araya	Farmer	Gereb Giba	12/04/2011
3	Ato Gebru Hagos	Farmer	Gereb Giba	12/04/2011
4	Ato Hadush Hailu	Farmer	Gereb Giba	12/04/2011
5	Ato Hailu Zenebe	Farmer	Gereb Giba	12/04/2011
6	Ato Muez Abraha	Farmer	Gereb Giba	12/04/2011
7	‘Keshi’ Haftu Welu	Farmer	Gereb Giba	12/04/2011

Table A.3: Name and address of vegetable traders participated in the interview

S/N	Name of Interviewee	Address	Date
1	Ato Hailu Negash	Edaga Sonuy	10/04/2011
2	Ato Weldegerima-	Edaga Sonuy	11/04/2011
3	Ato Kahsay Girmay	Edaga Sonuy	11/04/2011
4	NA*	Edaga Sonuy	12/04/2011
5	NA*	Edaga Sonuy	13/04/2011

* NA= not available. These Interviewees do not permit their name

Table A.4: Name and address of supermarkets participated in the interview

S/N	Name of the Supermarket	Interviewee	Address	Date
1	Seti Supermarket	NA	Edaga Sonuy	05/04/2011
2	Universal Supermarket	Welday/Tokash	Edaga Sonuy	06/04/2011
3	Hiwnet Supermarket	NA	Edaga Sonuy	06/04/2011
4	Selam Supermarket	NA	Edaga Sonuy	07/04/2011
5	John Supermarket	Samiel	Edaga Sonuy	08/04/2011

Table A.5: Name and address of eateries participated in the interview

S/N	Name of the Eateries	Interviewee	Address	Date
1	DH Cafeteria	NA	Hawezien Adebabay	04/04/2011
2	Yordanos Hotel and Restaurant	NA	Romanat	05/04/2011
3	Hakefen Restaurant	NA	Enda Micheal	07/04/2011
4	Gerealeta Restaurant	NA	Aserte Shudushte	08/04/2011

Appendix-6 Photo Gallery

Figure 1: Spoiled onion (left) and tomato (right) discarded on the street

Figure 3: Some of the interviews conducted; with Yordanos restaurant manager (left) and vegetable trader (right)

Figure 6: FGD conducted with vegetable growers at Gereb Giba Sub-district