

**FARMING SYSTEMS AND STRATEGIES  
FOR SUSTAINABLE LIVELIHOOD IN ERITREA**

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## ABSTRACT

This paper examines various farming systems including cereal farming, fruit cultivation and the practice of out-of-season vegetables in the different altitudinal zones of the state of Eritrea and suggests strategies for sustainable livelihood of the populace. The two vertical zones, lowland and highland characterize the farming systems. Mid-slopes also have an important role in determining the practices of agriculture, where farming is done only on the narrow patches of the terraced fields. The highlands and mid-slopes agricultural system is characterized by the dominance of cereal farming particularly barley, wheat and maize while in the lowlands, groundnut and sorghum are the main crops. Irrigation facilities in the state are negligible due to lack of perennial sources of water. Rivers are dried up during the winter and summer. Therefore, cereals cover about 80% of the rain-fed area. Cultivating fruits particularly banana, apple, guava and papaya and out-of-season vegetables are also practiced in the highlands and mid-slopes but their proportion in the cultivated land is smaller, on the one hand, and they are traditionally cultivated and domestically used on the other. The variability in the highlands and lowlands farming system is extremely high because of extreme variation in the climatic conditions, while the scope of expansion and modernization of the cropped land is limited. The marginal farms have less than one ha area in the highlands and about 2 ha area in the lowlands. Soils, except along the valley sides or some areas of mid-slopes, are very poor in contents and hindrance for high yield of crops. Furthermore, lack of infra-structural facilities in the field of agriculture does not provide a base for sustainable livelihood. Under such circumstances, the cultivation of fruits and out-of-season vegetables is essential because of their tremendous scope and availability of favourable environmental conditions. Data were gathered mainly from the secondary sources. A case study of the two farmlands (highland) to discuss the potential and input-output analysis of out-of-vegetables and wheat crops was carried out. Observation and participatory method was used for further interpretation of data. The study reveals that potential of cultivating out-of-season vegetables, fruits, and cash generating products is considerably higher than traditionally cultivating subsistence cereal crops.

**Key words:** Farming, highland, livelihood, malnutrition, sustainable

## INTRODUCTION

Poverty followed by malnutrition and starvation is the growing and common phenomena mostly in third world countries. It is partially due to depletion of natural resources and because of underdevelopment of the areas in terms of inappropriate use of technological advancement. In most third world countries, agricultural practice is the only means of livelihood, which is insufficiently operating, because the mode of cultivation is traditional and the crop production is subsistence in nature

The state of Eritrea has traditional societies. Cultivating subsistence cereal crops is the mainstay of the people as about 80% people are engaged with this practice. Therefore, it is the main base of livelihood. The role of other development activities in the economy is negligible. Thus, the state falls in underdeveloped economy. But when we compare the state with other African countries in terms of livelihood, the situation is better here because the state has comparatively less population density (32.2 persons/square km). Currently, the production of crops is sufficient to meet the food requirement of the people. As population increases more than the crop production, strategies for sustainable livelihood through cultivating cash generating crops become crucial.

Agriculture is the backbone of the Eritrean economy as well as the main option of livelihood for the people. About 80 percent of the population depends on agriculture and its allied fields such as crop production, livestock, forestry, and traditional fishing. Although agriculture is the most important sector in terms of employment and livelihood, its contribution to the country's gross domestic production is relatively moderate, estimated at 21 to 30 per cent [1]. This is comparable to the average of about 30 per cent for sub-Saharan African countries. Agricultural production levels in Eritrea are generally low, with average yields per hectare perhaps among the lowest in Africa [2]. The contribution of agriculture to exports is also modest with most of the exports coming from the livestock. The current situation of low performance in agricultural sector can be attributed primarily to the more than three decades of armed struggle for independence [3, 4].

Two types of land forms, which are extremely different from each other, characterize Eritrea. The lowlands are influenced by the hot arid climate, while the highlands are dry and cool. The environmental conditions are not feasible. Soils in the lowlands are unproductive because in most of the areas, soil contains sands while in the highlands the upper surface of soil is eroded due to degradation of land. Cereal crops dominate the cropping pattern and the ratio of fruits, out-of-season vegetables and other cash generating products in the cultivating land is lesser. Meanwhile, the variability in the climatic conditions both in the highlands and lowlands pose potential for the cultivation of fruits, out-of-season vegetables, and cash generating products. Crops are grown mostly during the five months of summer season, which depends on the availability of adequate rainfall. The main objective of the study is to evaluate the current outcome from the subsistence cereal crops and potential of cash generating products such as fruits and out-of-season vegetables. The major research question is: what would be strategies for enhancing and diversifying livelihood options?

## METHODOLOGY

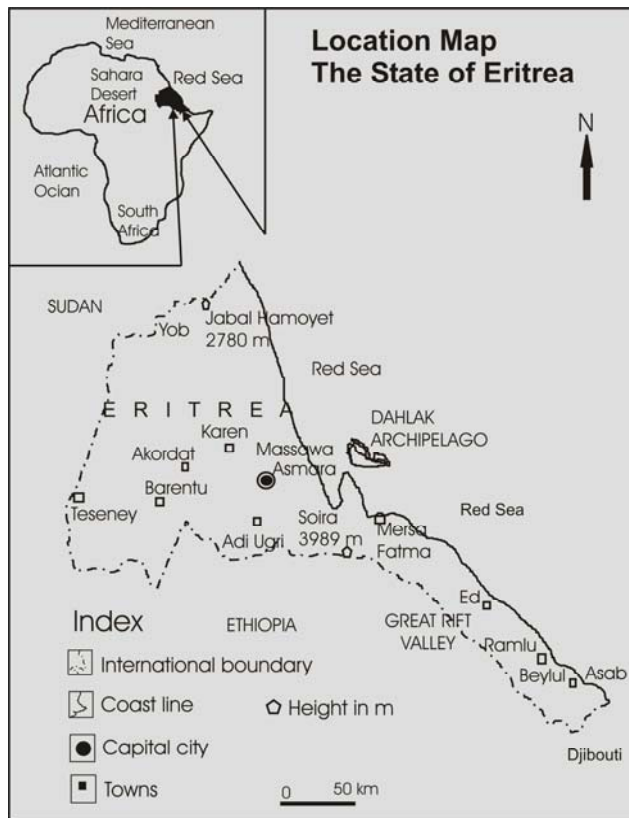
### (1) STUDY AREA

Located on the western shore of the Red Sea, the State of Eritrea is extended from 12° 42' N to 18° 02' N and from 36° 25' E to 43° 10' E. Red sea in the east, the Republic of Djibouti in the southeast, the Sudan in the northwest and Ethiopia in the south delimit the state (Figure 1). Its sea coast stretches for about 1216 km. The total geographical area is 1, 240,330 km<sup>2</sup>. It has over 360 islands. Elevation ranges from 100 m below the sea level (Danakil depression) to over 3013 m (Emba Soira). Mean annual temperature varies from 16.1°C in Asmara to 29.5°C in Massawa. The state comes under the tropical regime but the highlands of Maekel, Debub, southern Anseba, and southern Gash Barka zobas, experience comparatively low temperature (Table 1).

The total annual rainfall tends to increase from north to south. It varies from less than 200 mm in the northwestern lowlands to more than 700 mm in southwestern lowlands bordering with Ethiopia. In some places, Filfil and Solomuna (Figure 2), the mean annual rainfall exceeds 1000 mm. The coastal plain receives very little rain, usually 50 mm to 180 mm. In the highlands, average rainfall varies between 500 and 700 mm. There are two rain seasons in the highlands. The first occurs from March and April and second occurs between June and September. Highest humidity is found in the coastal regions, which is more than 60%. The remaining areas have very dry weather. Due to great variation in altitude, climate and topography, the vegetation cover of Eritrea shows extreme diversity. According to a report by the Ministry of Agriculture, before the twentieth century, the status of the highlands forest coverage was estimated at about 30 percent of the total landmass. In 1950, it was further reduced to 11 percent, while in 1990, the forest cover again reduced to 0.43 percent. At the very onset of independence, the Eritrean government realised the need for afforestation and the establishment of closures began on the degraded sloppy land. Consequently, about 30,945 ha of land in the highlands are now under closures, which accounts for 1.7 percent of the total highlands area [5]. Dense forests are found in Semenawi Bahri along the Eastern escarpment and Rora Habab in Sahil, Mangroves along the coastal regions, Savannah grassland in between 200 m and 700 m and grasses and plants, which are dwarf-umbrella-shaped acacia species, dominate among vegetations.

Eritrea accommodated with a wide range of animal species such as elephant, hippopotamus, buffalo, giraffe, greater kudu, wild ass, Nubian idex, waterbuck, lion, leopard, cheetah, colobus monkey and others. Two species of animal *Loxodonta* African and Greater Kudu are currently endangered. There are two animal protected areas, Gash-Setit and Buri Peninsula. It is also rich in marine resources. The red sea is the main fishing centre. There are over one thousand kind of fishes that live in different habitats such as mangrove forests, swamps, salt marshes, coral reefs, sea grasses, seaweed, sandy bottoms and rocky environment of the continental shelves. The main fish species with commercial importance include lizard fish, mackerel, tuna, surgeon, butterfly fish, grunts, wrasses, snappers, angle fish, domsel fish and groupern.

The soils are sandy and sandy loam texture in general in areas where parent materials are derived from granite, gneiss, sandstone and quartzite. Soils are coarse in texture in the basaltic areas. These soils are low to medium in organic matter and nitrogen contents, low to high in phosphorus and potassium. However, in some valleys and depressions, these soils are deeper and agricultural potential is relatively good. In the upper plains, soils are generally of better quality than in most other areas of highland, consisting of Vertic Cambisols and Luvisols. These have traditionally been areas of intensive cultivation over the centuries, and today continue to be among the most agriculturally productive areas of the highland [6, 7]. The rural population consists mostly of sedentary farmers engaged in growing staple crops for local consumption. However, many households still migrate seasonally with their animals to additional pasture and agricultural land in the eastern lowlands and in the southern and western plains. Livestock constitutes an important part of rural families' income. Rural people continue to this day to live in communities of mostly communally owned lands, the boundaries of which have largely remained unchanged for centuries [8, 9]. This structure of tenure and traditional community management is in the process of being dismantled by the present Government of Eritrea [10].



**Figure 1: Location map of Eritrea**

## (2) DATA COLLECTION

This study was primarily based on secondary data, which were collected from the different sources such as, Ministry of Agriculture, Meteorological Department, and Horticultural Department. A case study of two farmlands, out-of-season vegetables and wheat crops was carried out. Input and output analyses were done of the both farmlands to understand the viability and potentiality of wheat crops and out-of-season vegetables. A questionnaire was framed and filled in after interviewing the owners of these farmlands. The author made eight visits of the study area and discussed thoroughly with the officers and extension workers of Ministry of Agriculture and the local people about current farming systems and future viability of crops. Observation and participation methods were taken appropriately for further interpretation of data.



**Figure 2: Filfil and Solomuna area in Eritrea receives highest average annual rainfall. Photo by Vishwambhar Prasad Sati**

## RESULTS

### Land use pattern

Land use pattern is characterized by the availability of natural resources, which exhibits the degree of development of an area or region. This varies between the places, depending upon the availability of natural resources in the region, and categorizes as cultivated land, non-cultivated land, wasteland, and forestland.

Agriculture is the mainstay of the Eritrean national economy accounting for over 12% of the national gross domestic product and over 80% of the national labour force. Table 2 shows

land use classification in Eritrea. Out of the total land area (12.4 million ha) 25% is suitable for agriculture, however, only about 522162 ha (4.28%) is being cultivated of which about 500163 ha (over 95%) is under rain-fed conditions (1998) and the remaining 22000 ha (4.21%) is irrigated. The cropping pattern also varies from cereal crops to cultivating pulses, oil seeds and vegetables. Once in a year, particularly during the rainy season, a crop is grown. Wheat, barley and maize are grown during June-July to September-October. The percentage of area under fruits and vegetables is remarkably low (0.18).

Despite a 400% growth in population since the late 19<sup>th</sup> century [11], the amount of land under cultivation has not generally increased by more than 50%, the tendency being to reduce individual plots of land and decrease fallow periods. Additional land appropriated for cultivation has tended to be marginal and grazing lands rather than woodlands.

### **Existing farming system**

About 80% population of the country depends on the mixed farming systems, rain-fed agriculture and livestock based production. The farming systems have been characterized by the cultivation of traditional crops and adoption of old mode of agricultural practices along with low production and productivity of crops for centuries. With the advent of the Italian colonial rule, commercial farming was introduced to meet the consumption demands of the urban population, to supply local industries and to generate foreign exchange earnings. However, most of the infrastructure created by the Italians was ruined during the war for independence. The existing farming systems are as follows:

#### **(a) Traditional farming**

Traditional rain-fed agriculture accounts for more than 95% of the cropped land. The determinant factors of the traditional farming system are the availability of rainfall and soil moisture with little or no modern agricultural input. These farmers cultivate mainly cereals, pulses and oilseeds. Cereals cover about 80% of the rain-fed area. Sorghum is by far the most important crop, followed by barley, wheat, teff, maize, and the millets. Sesame is the main oil crop and faba bean is the leading pulse.

The great majority of the farmers in Eritrea operate agriculture on small scale. Despite much local and regional diversity, they share a number of following important characteristics:

- Most small farmers operate on an independent basis, either as independent land owners or under rental arrangement allowing them to make production decisions.
- They depend mainly on family labour supply.
- Small-scale farmers are less likely to use capital for commercial inputs like fertilizers, pesticides and equipment.
- The small farmers tend to use credit for consumption needs rather than for purchasing farming inputs.

### **(b) Commercial farming**

In 1962, there were a total of 33736 ha of land registered as concession land divided among 615 holdings. The largest single concession was of some 16000 ha to the Alighidir Estate while Elaberete had about 1800 ha. These two largest estates are engaged in commercial activities and both are operating well below capacity with technical and financial difficulties. Many more commercial farms have been established and they are engaged in the production of vegetables and fruits, crops, dairy, poultry, beekeeping and coffee. The distribution of commercial farms in the Zobas in 2001 is shown in Table 3.

Commercial agriculture in Eritrea to a great extent can be referred to as horticulture that is production of vegetables and fruits primarily near riverbanks and dams. This has relatively assured system of irrigation leading to uniform environmental conditions and scope for the use of better inputs like fertilizers and pesticides. Farm fields, dairy farming and poultry farming can also be considered as part of commercial agriculture. There are some large farms such as Gash farm, Barka farm, Alighidir, Elaberete Agro Industry and Sawa-Agro-Industry and Afhimbol farms, which are well developed in terms of available facilities. These farms are concerned either with horticultural crops alone or in combination with cereals and other crops. Commercial farmers use surface and drip irrigation for high value crops, mainly for horticultural crops. The farms are located along the river basins of Gash, Barka, and Anseba. The principal horticultural crops grown by these commercial farms are banana, papaya, citrus, mango, onion, tomato, peppers, eggplant and okra while among the other crops, sorghum and cotton take the lead, respectively. Land use and farming systems in Eritrea is complex. In one specific area, we can observe grazing, poultry, rain-fed crop farming, irrigation farming, fruit farming, and vegetable farming. While, the Eastern lowlands is mostly devoted to nomadic and semi-nomadic pastoralism, within some areas there are isolated farming lands found such as Bada in southern Red Sea zone and Foro, Dheib, Shebah, Imberemi, Naro, Nacfa, and Bakla in the northern Red Sea zone.

### **(c) Rain-fed farming**

Cultivating crops is mainly rain-fed in zobas Maekel, Dehub, southern Anseba zone, and southern Gash Barka zone. These areas cover highlands of the state. The important crops, which are grown in the highlands, are wheat, barley, maize, teff, African millet (Dagusha), oil seeds (linseed, Niger seed, nihug), and pulses (broad bean, chickpeas, lentils), which require cool climate. The crops, which are grown in the lowlands in zoba Anseba, Semenawi Keih Bahri, and Gash-Barka include sorghum, maize, sesame, groundnuts and pearls millet (blug). Per ha yields of barley, finger, millets, sorghum, maize and pearl crops are high. Table 4 shows the highest yield is obtained by finger millets and groundnut, which is 12-quintal per ha followed by wheat, barley, maize and sorghum equally (all have 10-quintal per ha yield). The other crops are pearl millet, sesame, linseed, nihug, chickpea and broad bean, which have 8 and 7-quintal per ha yield. The average crop yield is 6-quintal per ha. Sorghum is widely cultivated, and occupies the largest area under cultivation followed by barley, wheat and maize. In a nutshell, 83.3% of the cultivated land is devoted to cereals followed by pulses (12.5%), oilseeds (3.4%), fruits, and vegetables (1.69%).



#### **(d) Irrigation farming**

Irrigation farming is mainly practiced in the lowlands. In the places of eastern lowlands like Sheib, Shebah, Naro, and Iberemi, farmers divert river water into their farmlands and produce abundant crops, mostly sorghum. The farmers of western lowland, between Hagas and Akerdet as well as between Akerdek and Swaw, depend on ground water for irrigation. Due to scarcity of rainwater and perennial rivers/streams, very small proportion of land is irrigated.

#### **(e) Cash crop farming**

Some farms are used for producing cotton, coffee and sesame crops. Coffee in Semenawi Bahri and Debubawi Bahri regions is rain-fed while in Ali Gedr, it is grown by irrigation from the Gash River. Sesame is largely grown in Zoba Gash-Barka, particularly in Ali Gedr, Goluge, and Om Hager and is rain-fed.

#### **(f) Fruit farming**

Fruits are produced mainly by irrigation from groundwater (drill-holes) and rivers. The most common fruits are orange, lemon, banana, mango, papaya, water melon, peach, tangerine, and date palm as well as cacti fruits (Beles). Distribution of fruits in the state is shown in Table 5.

#### **(g) Vegetable farming**

Vegetable crops are booming in Eritrea, as there is high demand for vegetables with the growth of urban population. Vegetable farming is highly concentrated around urban centres and along the main roads. The main vegetable growing areas are around Asmara, Dekemhare, Maerreba, Segeneiti, Abu Salama, Dubarwa, Mendefera, Keren, Hagas, Akerdet, Elaberete, Habero, Deghe, Tesenei, Ghindae, Goluge, and Nakfa.

### **Strategies for sustainable livelihood**

Planning and policies along with availability of natural resources play a vital role for development in any region or an area. For sustainable farming, these factors work tremendously. Human resource development is one of the most prominent factors, which also determines the economic growth and sustainable development of the country. All the way, the study area has lagged behind in terms of rational planning and policies on the one hand, and availability of plenty of natural resources on the other. Whatever the resources available in the State of Eritrea, they may be used sustainably particularly the cultivation of crops. The strategies for sustainable livelihood in Eritrea are as follows:

### **Development of sustainable farming**

The discussion on the existing farming system suggests that though diversity in cropping pattern is seen everywhere in the state, per ha yield of crops cultivated is very low. To a

certain extent, the existing farming system is suitable for maintaining the ecology of the terrain, but in terms of sustainability, it leads to food scarcity and malnutrition. Sustainable farming system is essential and could lead the way to food security and reduce malnutrition for the next generation particularly in the wake of growing population. The following suggestions are given for sustainable farming systems:

**(a) Intensive cultivation of fruit crops:** The climatic conditions, varying from tropical to temperate, give way to growing various kinds of fruits in the lowlands and highlands, respectively. Banana in Haikota, Goluge, Gogne, Tekrerit, Mogoraib, Akerdet, Keren, Filfil, Solomuna areas; mango in Mai Aini, Mekelasi, Azreket, Dekemhare; water melon in Massawa, Figret, metro zerit and date palm in and around Gulf of Zula and Sheib can extensively be grown. The lowlands of the state have favourable environmental conditions for growing these fruits. In the highlands, orange in Haikota, Tokombia, Binbina, Gogne, Tekrerit, Keren, Filfil, Elabered, Solomuna, Ghindae, Ala, lemon in Haikota, Goluge, Gogne, Elabered, Tokombia, papaya in Nakfa, Keren, Mai Habar, Elabered, peach in Dekemhare, Mai Idaga and Ala, grapes in Dekemhare, Ghindae, *aket* in River Barka and *beles* in Ala, Segeneiti, Senafe, Nakfa and Gebel are the main fruit crops in these production areas. Production of these fruit crops is still low, and is locally consumed during the fruits growing season.

**(b) Cultivation of out-of-season vegetables:** Vegetables are grown only nearer to the towns and cities, but their proportion in the cultivable land is negligible. If a sizeable proportion of cultivated land is transformed into the cultivation of out-of-season vegetables, it will boost up the economy of the region. Already there are many farmlands existing in the lowlands, providing sufficient production of these crops. The out-of-season vegetables can be grown along the streams in both the highlands and lowlands because of the availability of water particularly during the rainy seasons. In the highlands, potato, onion, cauliflower, radish, carrot, tomato and beans can be grown extensively. Similarly, in the lowlands, sorghum and watermelon are environmentally suitable. Out-of-season vegetables have great potential in Eritrea mostly in the mid-slopes and highlands [12]. Table 6 shows a case study of two farmlands in Tokor catchment of Maekel Zoba. The cultivation of out-of-season vegetables and wheat crop is done in these farmlands separately. Input-output analysis was done in both farmlands. It was noticed that input for producing crops is almost equal in both farmlands, while output varies as out-of season vegetables has about four times higher (USD 8000) than wheat crops (USD 2500). While discussing with the owners of these farmlands, it was observed that the people were willing to cultivate cash generating products in lieu of the cereal farming but due to lack of irrigation facilities they grow cereal crops, wheat and barley in particular.

Like this farm, there are about 20 farmlands in between Godaif and Adarba village, where out-of-season vegetables are grown 3-4 times in a year and supply the required demand of vegetables for Asmara town. This belt is fairly productive in comparison to many of the areas because the upper layer of soil, up to 30 cm deep, is fertile (black soil) and the ground water availability further accelerates the scope of cultivating off-season vegetables. There is a great need of commercialization and modernization of these crops, while currently it is being supplied only for the local consumption.

**(c) Cultivation of pulses:** Pulses can extensively be grown in the state, which can lead the way to sustainable livelihoods. Lentils and beans are the leading pulse crops, which are well adapted in the ecology of region and provide high per ha yield.

**(d) Cultivation of oilseeds:** Mustard oil seeds and linseeds are already a part of farming systems but their proportion in the cropping pattern is marginal. In the middle slopes of the hills, these two oil seeds can be grown extensively.

**(e) Cultivation of groundnut:** The lowland areas are highly productive for cultivating groundnuts. Sandy soil, which is extensively found in the lowlands and dry climate, is favourable for the production of groundnuts.

**(f) Fish Production:** The Red Sea is a major fish producing area but the production of fish is limited only for domestic consumptions. If the production of fish is to be made available for export, it may lead the way for better livelihood.

### **Sustainable economic development**

Economic growth is synonymous with the sustainability of livelihoods in any area or region and it depends upon the availability of natural resources and development in the field of science and technology. The region taken for the study is economically underdeveloped because of lack of these factors. The underdeveloped stage of the region depends on various factors, which are responsible for slow (almost negligible) growth of economic development. The state remained under colonial rule for a long time, first under Italian and then Britons. During these periods, some progress was made in setting up of industries and also in agricultural development. But under Ethiopian rule and during the war period which lasted for about 30 years, the entire economy of the state was destroyed. The other factors determining the development of the country are lack of rational policies and planning for better use of the natural resources, whatever is available. There is a great need for developing the farming system on the one hand, and for exploring the possibilities of other natural resources after intensive survey of the areas on the other.

### **Industrial Development**

Eritrean manufacturing industries are mainly agro-based, processing basic consumer goods. Most of these industries are small-scale with employees of less than 10 persons. These account for 88% of the total industrial establishments of the country. In Eritrea, the textile manufacturing sector accounts for the highest number of employees followed by the Meloti Liquors, preservation of fruit and vegetables, and then processing and preservation of meat and meat products. This is based on the size of employment. Regional distributions of manufacturing industries are shown in Table 7.

Small-scale industries can be set up based on availability of farm produce and forest resources. Processing or preservation centres for vegetables and fruits are required to be set up in the locations where these are grown extensively. Fish production is the largest one in the country because of the Red Sea, and this can become a big industry for economic development and sustainable livelihood.

### **Water resource management**

Water is precious and vital for sustenance of life. It is a major tool for sustainable livelihood and without it life cannot exist. The region falls in an area where there is severe scarcity of water. The rivers are seasonal and there are no other sources of water in the entire area. Meanwhile, rainwater is the major source for surface and ground water and it can be harvested by implementing several schemes for its management. Subsistence cereal farming is the mainstay of the inhabitants of the region and most of the crops are grown during the rainy season. Because of limited water supplies for the crops, per ha yield of the crops is lesser. Yield of crops can be improved after harvesting rain water. There is a proverb that 'managing water means managing life', therefore, water management through rainwater harvesting is essential. Rainfall generally occurs from June to September. The other season for raining is from March to April, when the highland areas receive rainfall. Whatever and wherever rainfall occurs is lost by run-off through the different channels and the area remains dry [13]. Construction of small dams, ponds, field bunds, check dams will be helpful for accumulation of water that would be used for irrigating land.

### **CONCLUSION**

Farming has been the occupation of rural people. Until now 80% of the country's population depends on agriculture and livestock farming for their livelihood. Besides, the experience or the intuition passed on from parents to children, on the ways and means of raising agricultural products, taking care of livestock and beekeeping has been practiced for ages. What is more, on water and soils conservation, though limited in capacity and resource availability, a number of interventions have been exercised for long. Terracing, flood control, river diversion, watershed development, furrow and canal irrigation, construction of cisterns as well as developing check dams, through a village campaign has been part and parcel of the people living specially in the highlands. Besides this, people living in the lowlands have also had the culture of raising livestock and sustaining life depending on animals and their products. Harnessing opportunities on the ground and capitalizing on material and non-material aspects of maintaining agricultural livelihoods needs to be given considerable priority.

Rational planning and policies for the regional development perspective of the state seems not to be up-to-date and requires a holistic approach. Environmental degradation is more a problem of relationships among people competing for productive resources than of relationships between people and habitats [14]. Protection of interests of indigenous population, therefore, must assume the focus as well as priority for interventions aimed at sustainable development. Unfortunately, human dimensions of environmental and developmental changes remain poorly understood [15]. Strategic approaches of developing new technologies or thrusting those which have proved successful elsewhere must be replaced by looking into the indigenous repository of knowledge and technology followed by necessary refinements therein.

Sustainability of any development intervention would depend upon a logical consideration of these opportunities and constraints. Huge variations in physical, biological and human systems in the region demands careful consideration of locational specificities, while

designing and implementing any development intervention. Further, since scientific knowledge base of the region is limited, efficacy of any intervention must be thoroughly tested before it is spread on a large-scale.

Eritrea, being a third world country is prone to lack of many basic necessities. Being a new and underdeveloped nation due to a long period of destructive war, the challenges faced on assuring food security impose greater problems. Inadequate and ultimately lack of rainfall, lack of developed basic infrastructure and all other unfavourable factors are all impediments that still need a lasting solution. However, among all these challenges there are encouraging points which need to be fostered and exploited [16].

Eritrea is a young state with small geographical area and limited natural resources. Subsistence agriculture is the main occupation of the people. Limited availability and viability of the utilization of available resources can be seen everywhere. Under the given circumstances, what will appear to be more suitable policies and planning, which could lead to sustainable farming systems and livelihoods? Rain water harvesting, soil conservation, fruits and out-of-season vegetable cultivation may be the most useful strategies for enhancing livelihood options.

The highlands have the potential for the cultivation of fruits, vegetables, and flowers because of favourable climatic conditions. These practices will lead to sustainable livelihoods and will help to reduce environmental degradation. However, it needs to be taken with rational planning and controlled implementation. People involvement towards transforming the traditionally cultivated land into cultivation of fruits, out-of-season vegetables and flowers would be a milestone in the process of development of the state. Cultivating herbs in the highlands will provide ways for increasing income and augmenting employment. This study, therefore, concludes with the following suggestions regarding the attainment of sustainable livelihood of the state:

1. The economic package for the lowlands and highlands should be given according to the prevailing circumstances and planning concern.
2. Wherever possible, the farming system should be transformed from the traditionally subsistence cereal farming into the more economically viable cash generating crops according to the environmental conditions.
3. Fruit production is ecologically suitable in the highlands because they are environmentally sound and their economic value high, therefore, they should be intensively cultivated.
4. Sorghum and groundnuts can be grown extensively in the lowlands. Therefore, intensive care should be given to these crops in the lowlands.

**Table 1: Mean annual temperature for the selected towns according to altitude**

Places	Altitude (in m)	Mean annual temperature (° C)
Massawa	8	29.5
Assab	10	30.1
Akordat	638	29.0
Ghindae	962	24.5
Adi Ugri	2022	17.4
Asmara	2321	16.1
Adi Keih	2423	17.8

Source: Meteorological Department, Asmara

**Table 2: Land use classification, 1998**

S. No.	Land classification	Area in ha	Area in percent
1.	Suitable for agriculture	3.1 million	25
2.	Area under cultivation	522161	4.21
3.	Area under cereals	477043	3.85
4.	Area under pulses	6942	0.056
5.	Area under food grains	483985	3.90
6.	Area under oil seeds	16177	0.13
7.	Area under fruits and vegetables	22000	0.18
8.	Irrigated area	22000	0.18

Source: Land resource and crop production department, Ministry of Agriculture, 2001

**Table 3: Distribution of commercial farms in the Zobas 2001**

S. No.	Zoba	No. of investors	Area in ha		
			Allocated	Cultivated	Uncultivated
1.	Maekel	45	138	138	
2.	Debub	162	661	464	197
3.	Anseba	47	1698	598	1100
4.	Gash-Barka	1344	87580	38420	49160
5.	Northern Red Sea Zone	251	1712	1493	219
6.	Total	1849	91789	41113	50676

Source: Ministry of Agriculture, Asmara

**Table 4: Yields of crops per ha in Eritrea**

S. No.	Crops	Yield per ha (Quintal)
1.	Crops (average)	6
2.	Wheat and barley	10
3.	Finger millet, groundnut	12
4.	Maize and sorghum	10
5.	Pearl millet	8
6.	Sesame, linseed, nihug	7
7.	Chick pea, broad bean	7

Source: Ministry of Agriculture, Asmara

**Table 5: Distribution of fruits**

S. No.	Fruits	Producing areas
1.	Banana	Haikota, Goluge, Gogne, Tekrerit, Mogoraib, Akerdet, Keren, Filfil, Solomuna
2.	Orange	Haikota, Tokombia, Binbina, Gogne, Tekrerit, Keren, Filfil, Elabered, Solomuna, Ghindae, Ala
3.	Lemon	Haikota, Goluge, Gogne, Elabered, Tokombia
4.	Papaya	Nakfa, Keren, Mai Habar, Elabered
5.	Mango	Mai Aini, Mekelasi, Azreket, Dekemhare
6.	Peach	Dekemhare, Mai Idaga, Ala
7.	Grape	Dekemhare, Ghindae
8.	Water Melon	Massawa, Figret, metro zerit
9.	Date palm	Around Gulf of zula, sheib
10.	Akat	River Barka
11.	Beles	Ala, Segeneiti area, Senafe area, Nakfa, Gebel

Source: Department of Horticulture and Ministry of Agriculture, Asmara



**Table 6 (i): Case study of a farmland of out-of-season vegetable**

<b>Area</b>	<b>2ha</b>
Major crops	Onion, potato, cabbage, tomato and green leaves
<b>Input</b>	
(i) Water supply	From ground water (USD 300/year)
(ii) Human labour	Four person/day (Family members)
(iii) Seeds	From the crops (USD 50/year)
(iv) Fertilizer	Manure/chemical fertilizers (USD 100/year)
<b>Output</b>	
(i) Number of crops in a year	3-4 times
(ii) Cabbage production	4 quintal/crops (USD 2000)
(iii) Onion production	5 quintal/crop (USD 2500)
(iv) Tomato production	2 quintal/crop (USD 1000)
(v) Potato production	5 quintal/crop (USD 2500)

**Table 6 (ii): Case study of wheat crop**

<b>Area</b>	<b>2 ha</b>
<b>Input</b>	
(i) Water supply	Rain-fed
(ii) Human labour	4-5 persons (Family members)
(iii) Seeds	From the crops (USD 50)
(iv) Fertilizer	Manure/chemical fertilizers (USD 100)
<b>Output</b>	
(i) Number of crops in a year	Once in a year
(ii) Production	20 quintal (USD 2500)

Source: Primary collection by the author

**Table 7: Regional distributions of manufacturing industries**

Region	Large scale	Small scale	Total	Distribution %
Southern Red Sea	4	15	19	0.98%
Northern Red Sea	11	119	130	6.74
Anseba	11	221	232	12.02
Gash Bharka	2	253	255	13.21
Debub	18	360	378	19.59
Maekel	177	739	916	47.59
Total	223	1707	1930	47.46

Source: Ministry of Industry, Asmara

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