

CHAPTER 2: SOCIOGEOGRAPHICAL ASPECTS

2.1 Natural Conditions

2.1.1 Physiography

Republic of Yemen (ROY) is located in the south and southwest corner of the Arabian Peninsula, an area that is categorized as one of the arid regions of the world. It lies between latitudes, 12°-20° north of the Equator and longitudes 41°-54° east of Greenwich (CSO, 1997). Location of Yemen and landscapes can give it especial physiography zones that are, the Desert, the Eastern Plateau Region, the Coastal Plains, the western high mountain areas and the Islands.

- 1) The desert area in the northeast (*Arub Al-khali* (Empty Quarter) and *Ramlat As-sabatain*), rainfall and vegetation are nearly absent, except along its margins where rivers bring water from adjacent mountain and upland zones.
- 2) The eastern plateau, elevations decrease from 1200-1800 m at the major watershed lines to 900 m on the northern desert border and to sea level on the coast. Climate in general is hot and dry, with average annual rainfall below 100 mm, except in the higher parts, where several valleys run to this section, the major ones being Hadhramout and Al-Ghaydah.
- 3) the lowland or coastal plain region, which is 30-60 km wide and stretches about 2000 km over the coastal area of the country. The Plains are located in the west and south-west and are flat to slightly sloping with maximum elevations of only a few hundred meters above sea level. They have a hot climate with generally low to very low rainfall (< 50 mm/year). Nevertheless, the Plains contain important agricultural zones, due to the numerous wadis that drain the adjoining mountainous and hilly hinterland. These are named (from north to south) Mour, Surdud, Siham, Rima', Zabid, Risyan and Mawza'. 4) the western high mountain areas, which cover all the west high mountain area of the country, its elevations range between 600 and 3760 m above sea level. Climate varies from hot at lower elevations to cool at the highest altitudes. The western and southern slopes are the steepest and enjoy moderate to rather high rainfall, on average 300-500 mm/year, but in some places even more than 1000 mm/year. The eastern slopes show a comparatively smoother topography and average rainfall decreases rapidly from west to east. The valley to the east of this region, running mainly to Marib, is called Adhana; also several valleys such as Tuban, Bana and Hassan run to the south and finally, 5) Socatra island, where more exuberant flora and fauna can be found; and other islands in the Red Sea (Van der Gun, et. al, 1995, and Bamatraf, 1996).

So, most of the agriculture land is either located in the arid costal lowland or in the erosion-vulnerable semi-arid mountain terraces highlands. The lowlands consist of large and flat farmland; it is challenged by drought and desertification, due to shortage of rainfall and hot

climate. Therefore, farmland depends mainly on seasonal runoff from mountains or groundwater from deep wells. Main crops are sorghum, maize, vegetables, cotton, sesame, tobacco, and tropical fruits such as bananas, mangos, guavas, papayas and date palms.

On other hand, the highland is characterized by small terraces built many centuries ago in the cultivated land to control erosion and to stabilize the soil and to intercept rainwater in the steep land. The terraces are small at the top of the mountains, and then increase in size down-slope to the bottoms of the wadis where large terraces are formed. Rain is the main source of water for agriculture. Cereal crops are most common, other crops are pulses, subtropical and same temperate fruits, coffee and Q'at; the latter has been in expansion since the mid-1970s. Due to natural (e.g. random heavy rainstorms) and to socio-economical (such as male migration to cities and neighboring oil countries, the lack of labor and the increasing labor rate per day) conditions the terraces have not been maintained at the hill top. Moreover, in some other areas even the well-maintained terraces, but not cultivated because of migration, reduced lower yield per unit area compared to the effort applied to the land. The availability of imported grain remains to be of the major obstacle to farming system in this region.

2.1.2 Climate

Water and climate are the main important factors affecting agricultural production. Yemen has a unique climatic landscape compared to the other countries in the Arabian Peninsula. However, the climate of Yemen is arid and semi-arid with high sunshine duration and windy, all of which cause increasing crop water requirements. With shortage of rainfall and un-predictable duration and intensity, more stress on land and water resource is anticipated. Yemen climate is affected by the vicinity of three water bodies, a) the Indian Ocean, the Gulf of Aden and the Arabian Sea, b) the Red Sea, and c) the Mediterranean Sea. These three bodies are the sources of the moisture carried by the air entering the atmosphere of Yemen. The rain occurs in Yemen in two seasons. The first one occurs in spring (March-April) affected by the Red Sea Convergence Zone (RSCZ). The second one occurs in summer (July-September) affected by Indian Ocean, which is significantly influenced by the Inter-Tropical Convergence Zone (ITCZ). The unusual winter rain occurs in December-January affected by the Mediterranean Sea convergence system (Kopp, 1985, Aldomi, 1986, Bamatraf, 1993, Van der Gun et al., 1995, and Bruggeman, 1997).

Annual rainfall is varying from one geographical zone to another and from one year to another. It ranges from less than 50 mm/year near the coast and in the desert up to more than 1000 mm/year in some areas of the western mountain highland (the Yemen Mountain Massif). For crop production, the distribution of rain within the season is more important

than the total amount of rainfall. For instant the amount of rainfall in the village of Al-Ma'amirah (Taiz governorate), one of the detail studied villages, was 778 mm and 800 mm for 1997 and 1998, respectively. However, in 1998 the distribution of the rain was good during the growing stages of the crops in which the total amount of rainfall was greater by 22 mm than that in 1997. While in 1997 the rain was concentrated in the early period of the season and in the middle of the season before the head formation growth stage and then rain stopped till the late period of the season, when it rained again in mid of October. Consequently, the production of cereal crops from the same land was lower in 1997 than in 1998. Sorghum grain yields were 1.0 ton/ha and 2.0 ton/ha in 1997 and 1998, respectively; and straw yields were 3.3 ton/ha and 4.7 ton/ha in 1997 and 1998, respectively.

2.1.3 Water crises

The main sources of water in Yemen are the rainfall and the groundwater, that stored for centuries in the ground. Whereas, Yemen is suffered nowadays from shortage of water resource due to the population growth, growth of industry and improper water use in agriculture and the change of cropping pattern. The problem of water in Yemen is the negative gap between abstraction and recharging of groundwater. The average fallen quantity of the rain annually is approximately 60 billion cubic meters (BCM); most of it evaporates shortly after rainstorms. The remaining goes on the surface as runoff and/or percolated in the ground to recharge the groundwater. The runoff water is used in surface irrigation in the bottom of the valleys (*Wadis in Arabic*). However, in a big storm the extra water runs out of the catchments areas, which are known as the Arabian Sea basin, the Empty Quarter (*Ar-Rub-ALKhali in Arabic*) basin, the Gulf of Aden basin, and the Red Sea basin. The average yearly runoff to these basins is estimated to be about 2.0 BCM, with distribution as 28%, 9%, 27% and 30% to each basin respectively. The percolated amount is estimated to be in average 1.5 BCM, which is going to renew the groundwater, the second source of water. While the average annual abstraction is 2.1 BCM, which result an average negative gap of 0.6 BCM (Van der Gun et al., 1995 and Bamatraf, 1996).

Economical changes, urbanization and population growth have caused more water demand for industry, municipality and agriculture. Table 2.1 shows the total amount of water used was 2899 MCM (million cubic meters) in 1990, and it predicted the water demand in 2000 to be 3570 MCM. The expected demand for 2010 and 2025 are 3970 MCM and 4635 MCM, respectively. The amount of water used in 1990 in agriculture was 93.1% followed by municipal 5.8% and industrial 1.1%. Compared to that expected for year 2000 were 88.2%, 10.1% and 1.7% for

agriculture, municipal and industrial, respectively. The expected demand for 2010 is 83.9%, 13.9% and 2.2% for agriculture, municipal and industrial respectively, while the expected amount for 2025 is 79%, 18.1% and 2.9% for agriculture, municipal and industrial, respectively. Therefore, agriculture has used and will be using most of the water resources. The crisis would complicate, if the water management in agriculture were poor, such as the case of low efficiency in most surface irrigation, e.g. not exceeding 40%. The situation in hotter regions like western and eastern lowlands irrigation efficiency is lower, due to the high evaporation and poor management. However, Bamatraf, (1996) criticized the ratio of water used now and in the future in industrial activities, that it would be underestimated if water use in petroleum industry is considered. Therefore, the problem of water in Yemen will be worse in the nearest future without effective management and control of water use.

Table 2.1: Water demand throughout the period from 1990 to 2025 (MM³/Year)

	1990	%*	2000	%*	2010	%*	2025	%*
Agriculture	2700	93.1	3149	88.2	3328	83.9	3661	79
Industrial	31	1.1	61	1.7	90	2.2	134	2.9
Municipal	168	5.8	360	10.1	552	13.9	840	18.1
Total	2899	100	3570	100	3970	100	4635	100

Source: World Bank report 1993 and Van der Gun et al., 1995 * calculated by author

Poor water management and uncontrolled access to groundwater and abstraction started to show up the problems for examples, depletion of Sadah basin groundwater level is 40 meters during last 9 years (DHV, 1993) due to wells irrigation during 1980s. According to my opinion, the excess to groundwater started after 1984 when the government banned imported fruits and vegetables. Because private investments increased in agriculture in the low rainfall region such as western and eastern lowland, where the groundwater only used for irrigation and the digging wells increased without any control. Another example is water shortage in Sana'a basin as well as other highland basins (Van der Gun et al., 1995). Also, the city of Taiz has experienced and suffered from acute water shortage (it circulates every 3 weeks); which gives an example about poor water management.

All the above mentioned natural circumstances need adaptable policy on times and tools to deal with, such as enforced water law to control intensive abstraction, random well digging and inequitable water distribution (the water law was promulgated on August 31, 2002), policies to encourage investment in low-water demand crops which are suitable to Yemen's natural conditions, and policies dealing with modern marketing system to facilitate competition in neighboring markets.

2.2 Agriculture: Political Position and Trends

2.2.1 Agricultural policies

Food security and poverty alleviation are the major challenges to government that necessitate development of policies on different sectors to improve the quality of life. The agriculture activity consumed about 93% of water resource with low irrigation efficiency, i.e., not exceeds 40%. In general, rainfed and irrigated agriculture production is low, due to several reasons, i.e., land fragmentation, in addition to expansion of Q'at and dependency of rural economic on it an other challenge for groundwater depletion. The competition of agricultural production by imported, and the high output of irrigated product, increase neglecting of rainfed land and increase competition on groundwater, which in turn dropping down the water table, and decrease the water quality and decrease land production. All these caused development of manufacture and urban area in short time, in which water re-allocated to it (manufacture) against neglecting large farmland on rural area. Sequences of that continuous searching deeply in aquifers and transfer it from area to another. Or desalinate sea water with high cost, which will affect on population income especially for small farmers and low monthly income. So, the food security and water security are the national challenge which needs exhausting and condensed efforts. Therefore, it needs to establish Agricultural Development Planning, and give time for economy and society to start in adaptation with new situations. Planning, involved in redirect all the agricultural activities into aware activities out of farmland either in the rural or urban area. It need to expand the increase of using water harvesting, improve the tradition irrigation, introduce modern irrigation systems to elevate water use efficiency and introducing alternative crops for Q'at to reduce groundwater depletion and in the meantime, achieve economical reform, i.e., growing coffee, potato and other crops that can be exported in addition to grow protected crops such as vegetables. Despite of some people aim to achieve the general objective to uprooting the Q'at tree and live in Yemen without Q'at, unless the objective with more realistic is to reach compromise on social development in one hand and ambitions to reduce Q'at expansion and its effect on other hand, that is through adoption of step procedures on demand and supply to control continuous expansion of Q'at consumption and growing first and then gradual decrease areas occupied by Q'at plants and from consumption with help of whole people, communities and organizations (MPD, 2001).

2.2.2 Future trends

The security of life, food and road for people every where and every time in Yemen is the important right to achieve economic growth stability and to enhance/encourage local, regional

and international investment in the country. The food security has to be secured for all people in the country and has to secure for the possible increasing due to population growth, which is estimated to be 3.7% every year. Therefore, the five years economical plans; in the past and in the latest one express it intensively to recover the food demand and supply gap. The latest five year planning 2001-2005 has ambitious objectives in the program; i.e., 1) to increase agricultural production growth by 6% annually to achieve high level of food security and to increase agricultural exports through increasing the yield of land and employments, 2) to improve farmer's income to achieve better life which in turn will reduce poverty and disguised unemployment. To achieve these objectives several policies has been planned such as:

- 1) Encourage adoption and uses of modern ways of plant and animal production, and conduct of using high productive seed to use all cultivatable land and increase land output.
- 2) Facilitate the farmers to get all the necessary input, extension and all means of plant and animal diseases protections.
- 3) Propagation of modern irrigation systems, such as drip irrigation to increase water use efficiency and to conserve water resource.
- 4) Expand construction of small dams, traverses, reservoirs and irrigation system to improve the water use efficiency.
- 5) Support and encourage small farmers and in particular rural woman to develop productive activities on cooperative form to recover farmland fragmentation to provide chance of productive work and to improve incomes to reduce effect of poverty.
- 6) Strengthen the economical and technical connection between agricultural sections in one hand and remaining national economical sectors; particularly in food and agricultural input manufacturing.
- 7) Encouraging local private and foreign investment in agricultural sector, in both sections plant and animal and in marketing.
- 8) Review and declare constitutions to regulate trading of food productions to fit local, national and international new economical conditions.
- 9) Establish new department in the Ministry of Agriculture and Irrigation to regulate application of the protocols of health and plant health; also finishing and activation of agriculture quarantine and supervise the center of agricultural exports, and provide necessary devices and equipments for anglicizing and inspection.
- 10) Activation of the role of supervising on the trading of food commodities and establishing control points to reduce extremes of import to protect agricultural production from imported pests and diseases.

- 11) Preparation and organization export, especially to the Gulf States and to open new markets through bilateral trading contracts and joining to the integration of economical projects, regional merging and enlightenment on the requirements of agricultural contracts.
- 12) Consolidating and improving nets and marketing and export means, especially packaging to protect the product from spoiling and to guarantee the acceptance of the product in the markets.
- 13) To finish agricultural data base in production, marketing and foreign trading and to connect it on the internet.
- 14) Conserve of the agricultural environment, plants and animals and to stop all the polluted activities that affect on agricultural activities and animals breeding.
- 15) Encouraging production of cash crops that can expand, such as date palms, cotton, coffee, mango and honey.
- 16) Introducing new crops, which tolerate local conditions, such as olive plant with conducting the necessary researches (MOP, 2001).

From all the points above it can be concluded that agriculture is one of the important economic sector and it need effort from the government and farmers to recover the gap of food demand and to reduce the gap between the government policies and farmer desired. Because farmer's policy in agriculture might be conflicted with government policy, in which farmers invested in production of crop that give them high and fast income from farmland. So that they mostly invested in production of Q'at and other cash crops due to their knowledge of its demand in the market. While the government policy plans to invest on strategic food crop production, aim to food security, combating poverty and sustainable growth. It will be implemented through four frameworks: these are, natural (optimal use of the natural resources for agriculture), technical (updating technology), economic/social (enhance open market for agricultural production, source of financing, cooperative associations, support rural women) and legal/institutional (i.e., integration of the various institutional roles, support of creation of marketing companies, completion of the regulating legislation in area of agricultural input and output and provision of information on agricultural markets and data on output). The policy on agriculture is applied to enhance development of agricultural production. Therefore, the government established several Authorities such as Agricultural Research and Extension Authority with its seven branches all over the country aim on increasing the vertical production per unit area from providing high productive varieties tolerate to Yemen physiography and shortage of water. Also Tihama Development Authority, Northern Development Authority and Eastern Development Authority, all aim to develop the farmers and guide them to the new technology and sustainable

resources use to increase the production. Support corporations for proliferation of seeds and company proliferation of potato seeds and other vegetable seeds. Also government encourage rural development and established the rural finances such as Agricultural and Cooperative Credit Bank (ACCB), Agricultural and Fishery Production Promotion Fund (AFPPF) and Social Fund for Development (SFD), the later two are still too new. While the complex bureaucratic routine on the ACCB des-encouraged the farmers to take advantage of its services. It is noticed that the government investment on agriculture through the five year plans from 1972- 1997 valued US\$ 600 Million which equal to US\$ 20/ha, this amount is very low compared to the aim of the agriculture development and food security (MAI, 2000).

2.3 Agriculture in the Economy of Yemen

2.3.1 History of agriculture

Historically, Yemen had an in-caliginous wide knowledge in land and water conservation. Mountain terraces were built throughout steep slopes many centuries ago to control soil erosion, to reduce runoff and to increase effective rainfall. These terraces used to be cultivated totally and cereal crops mostly dominated the cropping pattern. Livestock and poultry were raised by families for their need of red and white meat, dairy products and eggs, the surplus was sold in the market. Even nowadays, countryside families in the villages raise livestock for milk, meat and for the dung; the later is used in arable land as manure and source of energy. In his PhD dissertation Steffen, 1979 described the effort exerted by Yemeni farmers on small terraced land holdings. He explained that the Yemeni farmer spares no effort to gain maximum profit from the scanty rainfall for the cultivation of his crops even on the most difficult terrain. He added that tremendous efforts are put into the production of grains the whole year around. Plowing, leveling, manuring (adding manure), breaking the clods of soil with wooden hammer, sowing, conducting additional irrigation water to the fields, harvesting, repairing the retaining walls of the terraces, transporting mold from the field of the lowest terraces to those laying in the upper part, removing the crops' residues etc. are some of the major operations which are carried out by the farmer by hand, using only simple tools and domestic animals. The special effort made and care taken, even in the area with marginal conditions, are remarkable and can be explained only by the fact that up to very recently the overwhelming majority of the country's population had no other means of securing their daily life than by intensifying agricultural production. He also added that he found the farmers' households to be, until recently, almost completely self-sufficient with regard to foodstuffs. Therefore, the areas with high population density generally coincide with the areas of intensive agricultural production.

Generally, it can be said that the traditional agricultural system of the Yemeni society and their activity in the agricultural production is that as the proverb words “Necessity in the mother of invention” in Arabic (*al-haja um al ikhtiraa*). As water and soil resources are limited in Yemen the intensive effort of the labor is applied in agriculture to obtain the optimal production of small terraced of land.

Weir, (1985) specified that Yemen historically has been the breadbasket of the Arabian Peninsula. Because the southwest corner of the Peninsula is distinguished ecologically from its arid interior, as Yemen has two seasons of rainfall annually, good, distributed climate with abundant rainfall and the most fertile land in the Arabian Peninsula. The arable land is about 15% of the country’s total land surface, used to grow drought resistant crops like sorghum, millet, barley ... etc. The work in agricultural land used to be organized by the family members. The family raised livestock for their diet. In the reports of the U.S. Department of State, (1975 and 1987) it is mentioned that the people of Yemen are hard worker and all the people are sedentary and living in villages scattered all over the mountain hills and in Tihama (western costal plains). In the middle of the twentieth century, Yemen was self-sufficient in crop production. Coffee production was the main exported crop and was a source for foreign exchange. The name of Mocha port city was synonym for coffee in the past. But, due to the civil war after the 1962 revolution (1962-1970) and due to frequent shortage of rainfall (drought) through the years the production of coffee and its exportation has fallen, therefore, Yemen has imported the majority of its commodities and foodstuffs. In my opinion, some other reasons are not mentioned, which may have caused the decline in coffee production after the revolution in 1962. These reasons include 1) migration of the population from the villages to main cities and to neighboring oil countries, looking for better income; 2) the change of world coffee production, in which for example Brazil and Colombia became lead coffee producer and exporter; 3) closing the border between the South and North Yemen, in which the production from the south and south east of North Yemen used to export through Aden seaport; and 4) the expansion of Q’at cultivation, which does not need effort like coffee during the growing season.

Coffee was the main export crop before the expansion of the Q’at on to coffee fields and other food crops. For instance, Yemen coffee, exported to the Soviet Union valued at 721,000 and 878,500 Rubles in the years 1930 and 1931, respectively. The coffee covered 99.03% and 99.2% of export to Soviet Union in 1930 and 1931, respectively. While, during the period 1956 - 1961 coffee cover 100% of export to Soviet Union (Gosarouve, Adhem, and Al-Makove, (1988) cited in Ghorab et. al, (1998)).

2.3.2 Land holding structure

There are problems related to land tenure, that is : a) Tenure System, in which land is divided into: private ownership; state ownership; waq'f land; and share cropping land. b) Tenure Security, which related to:- small size/ landlessness; rent/ sharecropping; and agrarian reform, its impact in south and east Governorate (former: South Yemen). The problems related to land holding structure are, the size is small, fragmentation which mean that number of parcels per holding is high. The reasons of that is, 1) population growth, which affect on size and land fragmentation; 2) misunderstanding of Islamic law of inheritance, or probably negligence of it. In Islamic sources “appropriation” is legible!! But people like to divide the inherited land between them (the heirs), which also affect on size and land fragmentation; 3) Landscape restriction, which affect on land fragmentation; 4) Land quality, which affect on land fragmentation, soil heterogeneity does not allow land consolidation; every heir want to get a piece of the “good” land; and 5) Social prestige restricts land consolidation.

In former North Yemen, the average holding size in 1983 was 2.3 ha; where the total cultivated land was 1,350,775 ha and the total number of land holdings was 591,071. According to Al-Rashahi, 1988, the land's fragmentation in 1983 was classified as follows; 16.3% of landholders had 1 parcel, 37.2% of holders had 2-3 parcels, 21.2% of landholders had 4-5 parcels, 17.1% of holders had 6-9 parcels, 7.8% of landholders had 10-19 parcels and finally 0.4% of landholders had 20 and more parcels. In 1993, the area per holder decreased to 1.6 ha; while total cultivated land 1,443,884 ha and the total number of the land holdings was 930,422 (CSO, 1997). Detailed statistics are given in Table 1, Appendix 2. These figures, however, demonstrate the decrease in holding size by about 30% in one decade.

In the unified Republic of Yemen, the average holding size in 1993 was 1.4 ha; where the total cultivated land was 1,569,854 ha and the total number of land holdings was 1,092,830. In 2000, the average area per holding decreased to 1.0 ha, the total cultivated land was 1,143,441 ha, and the total number of land holdings was 1,115,515. Therefore, the holding size decreased by 28.5% in 2000 compared with that in 1993 (CSO, 1997 and 2000).

Generally, it can be concluded that the problems of land holding structure and reasons are affecting on the resource management, which in turn will affect on land production, due to difficulties of introducing innovation to small and fragmented land. Even though, Yemen is an Islamic country and the Islamic law conducted for land inheriting like the other Islamic countries, but the uniqueness of Yemen is that most of land is small terraces distributed among the inheritors from generation to generation. With the increase of population, the land per capita

in the descending sequence is getting smaller and smaller what caused low efficiency of resource management and low land production.

2.3.3 Farming systems

The total area of the ROY is about half million square kilometers excluding the many islands in Red Sea and Arabian Sea (CSO, 2002). In which, 30.5 million ha are rocks, desert and urban areas, 15 million ha are arid and semi arid range land, 8.5 million ha are natural pasture land and 1.6 million ha are cultivated land (Bamatraf et al., 1996). According to recent Agricultural Statistics (MAI, 2001) the total agriculture land is 1.66 million ha, of which the cultivated land varies from 0.98 million ha to 1.4 million ha according to the amount of annual rainfall. The population density for the total land is 30 inhabitants /km², while for agricultural land it is 1373 inhabitants/km² (17.7 inhabitants /ha). That means, with the increase of the population the cultivated land per capita will be reduced. Evidently, the cultivated land per capita has decreased from 0.2 ha in 1970, to 0.06 ha in 1995 (Bamatraf et al., 1996). Meanwhile, the cultivated land has been fluctuating from year to another, due mainly to the amount of rainfall; yet the expansion of desertification and the encroachment of urban areas on to arable land remain to be a serious threat to this resource.

Common categorization of farming systems in Yemen was done according to source of water. Four systems categories are identified: rainfed, flood irrigated, spring irrigated and groundwater irrigated. In what was called North Yemen, Table 2.2 and Fig. 2.1, rainfed land decreased from 85% in 1975 to 77% in 1983; during the same period flood irrigated land did not change from 8%. While, spring irrigated land decreased from 5% in 1975 to 2% in 1983; during the same period groundwater irrigated land increased from 2% in 1975 to 12% in 1983. However, in the unified Republic of Yemen, Table 2.2 and Fig. 2.1, rainfed irrigated land was 61% in 1990, decreased to 54% in 1995 and decreased to 45% in 2000; while flood irrigated land was 9% in 1990, increased to 11% in 2000. Spring irrigated land was 2% did not change until 1995 and increased to 4% in 2000, meanwhile, groundwater irrigated land was 28%, increased to 34% in 1995 and increased to 40% in 2000. Increasing of groundwater irrigated land by 22% during 1983 and 1990, may it is due to declaration of law to ban import fruits and vegetables in 1984, which encouraged farmers to invest in groundwater irrigated land to produce cash crops such as fruits, vegetables and Q'at.

Table 2.2: Time change of cultivated areas in different farming systems

Year	Farming System								Total
	Rain fed		Flood		Spring		Groundwater		
	000 ha	%	000 ha	%	000 ha	%	000 ha	%	000 ha
1975	1285	85	120	8	73	5	37	2	1,515
1983	790	77	86	8	25	2	119	12	1020
1990	685	61	101	9	25	2	310	28	1,121
1995	579	54	100	9	20	2	368	34	1067
2000	515	45	126	11	46	4	457	40	1,144

Source: CPO, 1976, MAI, 1984, both for North Yemen. Data for ROY, compiled from MAI Stat. book of 1990, 1995 and 2000.

Until the 70s of 20th century Yemen was able to produce 92.8% of the total food consumed and imported only 7.2% (Nowaiser, 1988 and Ghorab, 1998). While from 1972 to 1983 the local production decreased to 44% from the total of consumption. In 1982 the local production covered only 41% of cereal consumption, 64% of the vegetable consumption, 22% of the fruit consumption, 12% of the red meat consumption, 17% of the milk consumption and 72% of the egg consumption (Al-Masuodi, 1985 and Ghorab, 1998). From the beginning of the 1990 the problem of local food production became much serious. The quantitative of cereal imports represented 74% of the total consumption, 33% of vegetable consumption, 20% of fruit consumption, and 23% of legume consumption in year 1992. Among the reasons of this food production gap was the low level of investment in the agriculture sector. For instant of the total investment during the three-year development program in North Yemen (1973/1975) only 9.1% was invested in agriculture. This percentage had increased to 17.6% in the first five year plan (1975/76 -1980/81), then it decreased again to 12.8% during the second five year plan (1982-1986) (Al-Masoudi, 1985 and Ghorab et. al, 1998).

According to John et al. (1979) in the early 1970's about 90% of the population traditionally got their livelihood from agriculture and animal husbandry, where cereal production covered about 90% of the agricultural production. Crop production in the highlands included sorghum, wheat, millet, barley, fruits, tomatoes, potatoes and lentils; while in the foothill wadis were cultivated corn, sugarcane and tropical fruit such as mangoes and bananas. In the Tihama plain, the hot coastal region, dates, tobacco, cotton, millet and sorghum were widely grown.

Table 2.3 shows the change in cropping pattern in Yemen during the period from 1965 to 2000. In the 60s and early the 70s most of the agricultural land used to grow cereal crops under rainfall. The apparent change of food consumption pattern from the middle 70s and on due mainly to male migration to cities and to neighbouring oil countries, the cropping pattern has changed accordingly. Instead of growing cereal crops, vegetables, fruit, fodder crops and Q'at

had expanded, because these crops are considered as cash crops. Yemen agriculture has transformed from subsistence farming into market-oriented agriculture.

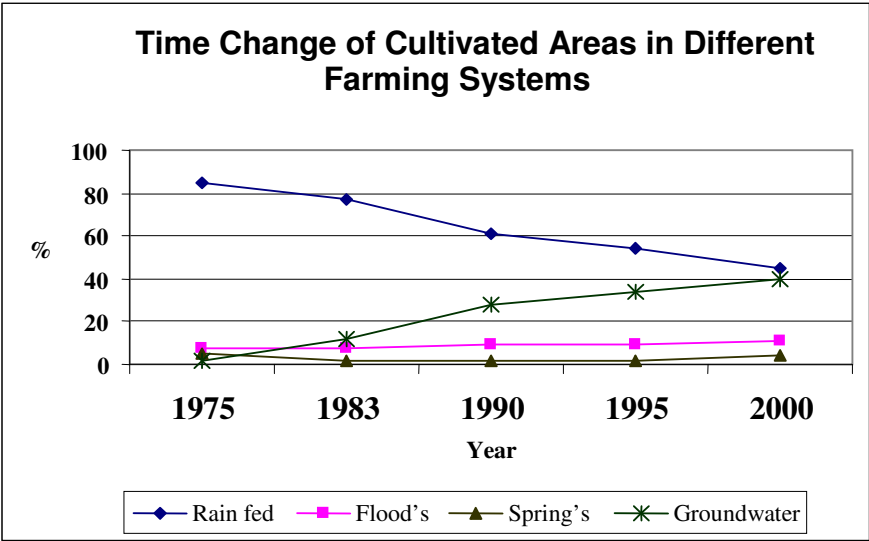


Fig. 2.1: Time change of cultivated areas in different farming system

It can be found in Table 2.3, in North Yemen, that the cereals crop decreased from 1,434,000 ha (0.8 t/ha) in 1965 to 845,000 ha (0.91 t/ha) in 1990, vegetable increased from 12,000 ha (7.5 t/ha) in 1965 to 52,000 ha (11.5 t/ha) in 1990, fruit increased from 4,000 ha (5.5 t/ha) in 1965 to 57,000 ha (5.5 t/ha) in 1990, industrial crops increased from 15,000 ha (0.5 t/ha) in 1965 to 33,000 ha (0.7 t/ha) in 1990, coffee increased from 5,000 ha (1 t/ha) in 1965 to 25,000 ha (0.3 t/ha) in 1990, Q'at was 43,000 ha in 1972 and did not found its change in the document and fodder increased from 3,000 ha (13 t/ha) in 1975 to 61,000 ha (9 t/ha) in 1990. Meanwhile, in the ROY, the cereals crop decreased to 620,000 ha (1.1 t/ha) in 2000, vegetable increased to 65,000 ha (11.9 t/ha) in 2000, fruit increased to 91,000 ha (6.5 t/ha) in 2000, industrial crops increased to 58,000 ha (0.9 t/ha) in 2000, coffee increased to 33,000 ha (0.3 t/ha) in 2000, Q'at increased to 103,000 ha (1.1 t/ha) in 2000 and fodder increased to 116,000 ha (13 t/ha) in 2000.

Looking at Table 2.3, even though, technology applied to increase vertical production for the cereal crop such as wheat increased from 1 t/ha in 1965 to 1.6 t/ha in 2000, with increasing of 330% in wheat area through 1965 to 2000. Yield of wheat is still low compared to the world production (2.6 t/ha) and to production in Middle East countries such as yield in Egypt is 5.99 t/ha, Syria is 2.3 t/ha and Saudi Arabia is 5.4 t/ha (FAO, 1998). Because wheat became the main crop consumed among rural and urban people, importing of it increased accordingly. Decreasing of coffee's yield from 1.0 t/ha in 1965 to 0.3 t/ha in 2000 explain the low invest and low effort applied in coffee's fields due to the competition of imported coffee and Q'at cultivation, because Q'at and coffee are growing in the same zone and climate and income of Q'at is higher than of

coffee and other crops. According to Ragaei (1986) the production of coffee in 1930s was 12,000 tons annually, it decreased in 1970s to 3,000-4,000 tons annually, the reason was not related to the competition of Q'at with coffee only but also related to the changes in market.

Table 2.3: Crop production and area change through 1965 to 2000

Crops		YAR					ROY		
		1965	1970	1975	1980	1985	1990	1995	2000
Sorghum and Millet:	Area, 000 ha	1260	1230	2040	681	690	643	540	463
	Prod, 000 tons	(970)	(984)	(1608)	(636)	(281)	(491)	(518)	(440)
Maize:	Area, 000 ha	4	16	62	31	38	52	43	32
	Prod, 000 tons	(10)	(32)	(104)	(49)	(43)	(66)	(58)	(48)
Wheat:	Area, 000 ha	25	30	70	63	59	98	102	87
	Prod, 000 tons	(25)	(33)	(90)	(65)	(63)	(155)	(171)	(142)
Barley:	Area, 000 ha	145	140	180	47	46	52	50	37
	Prod, 000 tons	(145)	(154)	(235)	(48)	(32)	(55)	(64)	(42)
Total of Cereals:	Area, 000 ha	1434	1416	2350	822	832	845	733	620
	Prod, 000 tons	(1150)	(1203)	(2037)	(798)	(419)	(767)	(810)	(672)
Pulses:	Area, 000 ha	40	50	74.5	75	25	49	54	52
	Prod, 000 tons	(40)	(60)	(91)	(84)	(44)	(76)	(70)	(63)
Potatoes:	Area, 000 ha	4	6	6.8	10.9	9	146	14	17
	Prod, 000 tons	(30)	(55)	(86)	(131)	(196)	(160)	(185)	(210)
Vegetables :	Area, 000 ha	8	10	20	27	19	38	40	48
	Prod, 000 tons	(60)	(100)	(19)	(261)	(371)	(536)	(484)	(565)
Total of Vegetables:	Area, 000 ha	12	16	27	38	28	52	54	65
	Prod, 000 tons	(90)	(155)	(279)	(392)	(567)	(596)	(669)	(775)
Sesame:	Area, 000 ha	NA	NA	10	10	10	19	23	32
	Prod, 000 tons			(6)	(6)	(4)	(9)	(14)	(18)
Cotton:	Area, 000 ha	12	10	30	5	6	10	13	27
	Prod, 000 tons	(5)	(10)	(27)	(5)	(4)	(8)	(12)	(28)
Tobacco:	Area, 000 ha	3	4	5	6	3	4	4	5
	Prod, 000 tons	(2)	(3)	(6)	(7)	(5)	(7)	(8)	(12)
Total of industrial crops :	Area, 000 ha	15	14	44	22	18	33	40	64
	Prod, 000 tons	(7)	(13)	(38)	(18)	(13)	(24)	(35)	(58)
Fruits:	Area, 000 ha	NA	NA	12	14	16	24	35	46
	Prod, 000 tons			(65)	(77)	(92)	(150)	(228)	(41)
Grapes:	Area, 000 ha	4	NA	9	12	14	17	21	23
	Prod, 000 tons	(22)		(42)	(56)	(81)	(142)	(151)	(156)
Palm Tree:	Area, 000 ha	NA	NA	--	[1250]	10	15	19	23
	Prod, 000 tons			(5)	(6)	(14)	(21)	(23)	(30)
Total of Fruits:	Area, 000 ha	4	NA	21	26	39	57	75	91
	Prod, 000 tons	(22)		(112)	(139)	(187)	(313)	(402)	(591)
Q'at :	Area, 000 ha	NA	43 *	NA	NA	NA	NA	NA	103
	Prod, 000 tons								(108)
Coffee :	Area, 000 ha	5	6	8	8	16	25	27	33
	Prod, 000 tons	(5)	(4)	(5)	(4)	(4)	(7)	(9)	(11)
Alfalfa :	Area, 000 ha	NA	NA	3	4	11	17	21	26
	Prod, 000 tons			(40)	(44)	(53)	(119)	(166)	(237)
Sorghum Fodder:	Area, 000 ha	NA	NA	NA	NA	NA	44	63	90
	Prod, 000 tons						(417)	(712)	(1213)
Total Land:		1510	1502	2535	994	970	1121	1068	1143

Source: CSO, 1976 and 2000; Agricultural Statistic, 1985, 1988 and 1990. Value between [] is the number of trees in 1000. NA= not available; * area of Q'at in 1972.

On the other hand (Table 2.3) also can explain the changes in the types of irrigation from early 70s to the end of 90s, in which the cultivated land under well irrigation increased from 2% in 1972 to 40% in 2000, while the cultivated land under rainfall decreased from 85% to 48% in the same period as shown in Table 2.2, because the area used for cereals production had decreased from 1.434 million ha in the middle of 60s to 0.6196 million ha in 2000. The difference in area is used to produce vegetables, fruit, animal fodder and Q'at, became most of these items grown under well irrigation or wells supplementary irrigation.

The increase of the animal fodder is related to two reasons. The first one is the farmers rely on the imported cheap grain (wheat and flour), so that the farmers especially in Tihama region

harvested the plants of sorghum before complete ripen of the grains and sell it as animal fodder. And the second reason is that the farmers in the mountains area, where the land is used for Q'at production, has high demand for the green animal fodder to cover the shortage of the production of their land, and to cover the need for animal fodder because the farmers in the mountain areas raise the domestic animals for their diet.

The information about Q'at area and production was hardly to find because it was not mentioned in the statistical yearbooks since 1972 where it was 43000 ha (Table 2.3). And then it was re-mentioned again in the statistical yearbook 1997 with an area of 93246 ha, which increased to 102934 ha in 2000 (Table 2.3) with total production of 88772 tons in 1997 and 108,043 tons in 2000; Q'at area increased during the 20 years by 140%. It is possible that the information about Q'at was mentioned indirect in statistic between 1972 and 1997 but under the items of "other" (Al-Makrami, 1987). However, Revri (1983) tabulated Q'at with other crops position in 1979/80 as 83764 ha, with 69% of it under spate irrigation, 7% under groundwater irrigation and 24% under rainfall irrigation. While, Kopp (1985) said that Q'at expanded through 1973 to 1980 by 2% to 7% of the cultivated land. More as, World Bank (1985) estimated that Q'at occupied 90,000 ha in 1985. However Bamatraf et al. (1996) predicted the area of Q'at might have exceeded, 100,000 ha; in the same article it was mentioned also that 300,000 ha of the land used to produce cereal crops is lost, most of which may be used for Q'at production by now. When, I asked Professor Kopp personally, about his estimation of the area of Q'at in Yemen, after he finished his lecture about Yemen in Berlin at February 18, 2000. His answer was the area of Q'at would not exceed 10% of the cultivated land. However, he wisely conclude that "the more the country you know the more difficult to describe". Unpublished data collected in the Yemen highlands region during the growing season 1991-1992 indicate that farmers would only allocated 30% of their land holdings to Q'at cultivation. Thus, it may be estimated that country-wide Q'at area falls within a range of 100-150 thousand ha (Bamatraf 2002, personal communication). However, the information about the production of Q'at is not consequently available in the statistical books as the other crops. So it is in my opinion that the production of Q'at covers the local market by 100% and it is locally consumed and because of the lack of the information about the surplus it is difficult to know if it is exported or not. Meanwhile, during the discussion on Q'at conference, it was mentioned there was little amount which as go daily to the neighboring countries. However, increasing of Q'at cultivation does not effect the export of fruit and vegetables during the period between 1990 and 2000 in which exports of fruit and vegetables were gradually growth (Sherif et al., 2002).

2.3.4 Contribution to 'gross domestic product' (GDP)

In 1972 agriculture covers about 70% of the gross national product, in which coffee was the major export product followed by cotton, salt and hides. However, in 1972 the first export product was cotton followed by coffee, hides and salt (statistic yearbook 1974/75). However, agriculture is the main source of economy of the ROY in which 60% of the population is dependent (Hashim, et al., 1991, and Al-Rashahi, 1988).

Agriculture sector including forestry and fishery is one important source of Yemen's economy. It is considered to be the first source of the Gross Domestic Product (GDP) among the other economic sectors. Looking to Fig. 2.2 the agricultural sector share in the GDP was 47% in early 1970s at current prices, and it gradually decreased to a share by 14.2 % in 2000, in addition to providing employment to 52% of the labor force and providing food for more than 75% of the population. So the, agricultural sector is important to reduce the effect of poverty among the rural population. Q'at formed an important part of Yemen's economy in general and of the agricultural economy in particular. Its share was 30% of the agricultural GDP and providing employment for 24% of the labor force (MOP, 2001). FAO estimated 56% of the working power is involving in agriculture, where the principal cash crops are coffee, cotton and fruit and the subsistence crops include sorghum, potatoes, wheat, and barley (FAO, 2000).

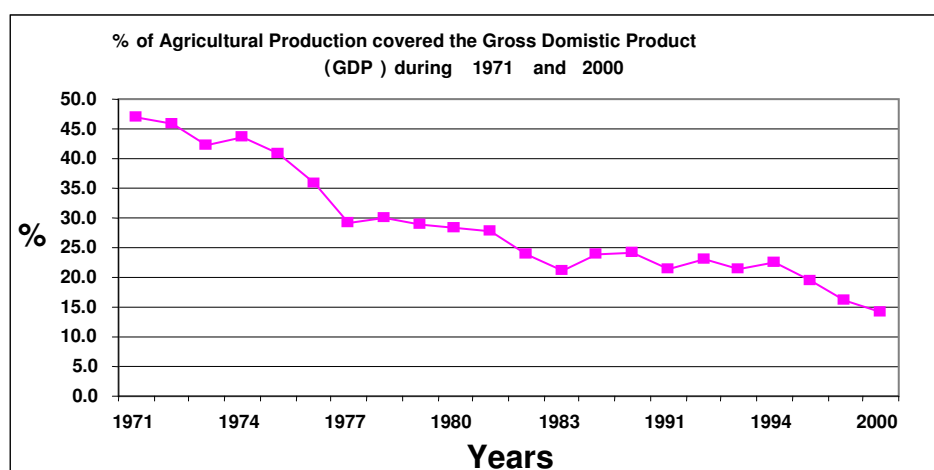


Fig. 2.2: % of Agricultural production covered the gross domestic product (GDP) during 1971 and 2000

Source: Data compiled from statistic year books, 1971 through 2000.

2.4 Population Growth and Agriculture Production

2.4.1 Demographical characteristics

In general report of the 1994-Census (CSO, 1996) contains detailed information about the population of Yemen. A brief summary is given in this section to highlight the major

demographical characteristics of the country. The total population of the ROY is about 15.8 million (1994 Census) including migrants (0.738 million) with 3.7% average annual growth. Resident population is 14.588 million, 51.2% are males and 48.8% are females, with urban population of 23.5% and rural population at 76.5%. The life expectancy at birth for the population is at an average of 57.5 years, where it is for male and female at 56 years and 59 years, respectively. The average percentages of the divorced and widowed in the population are 1.07% and 4.02% respectively. The average age at the first marriage is 24.8 years and 20.7 years for male and female, respectively (CSO, 1996).

On average, the population's illiteracy is 56 %, while it is 36.7% among male and 76.3% among female. However, illiteracy among female is higher than among male in urban and rural areas; in urban area it is 23% and 48% among male and female, respectively; while in rural area, it is 42% and 85% among male and female, respectively. The average literacy of population over 10 years of age is 44%, in which 26.75% are able to read and write only, 6.3% has primary level of education, 5.9% has preparatory level of education, 0.5% has diploma before secondary level, 3.1% has secondary level of education, 0.4% has diploma after secondary level and finally 1.1% has university level and higher level of education (CSO, 1996).

Referring to the census of 1994, the mean age of the population is about 21 years, while the median age of the population is 14.5 years in which it similar for male and female. Therefore, 50% of the populations are below an age of 15 years. This will affect on the economic resource in the case that the productive population is small and the percentage of dependency (support) per family is high. In other words, the percentage of the economic dependency is 439.3 persons (it means that every 100 economically active support 439.3 persons including themselves). The numbers per family who want sustenance or support are in the average of 4 persons and the supporter will be the household, meanly in this case is the father. The total of population 10 years old and higher involved in economic activity are 3,311,989 inhabitants from this number 22.7% unpaid family worker, 0.1% unpaid worker, 1.5% employer, 35.8% self-employee and finally 40% are employee. In average, 49.66% of population's labor force from age of 10 years and higher involve in agriculture and fishery sector, 40.71% of male and 84.24% of female (CSO, 1996).

The population in 2000 is 18.261 million in which 50.07% are male and 49.93% female 73.7% of them are living in rural and 26.3% are living in urban areas the average household size is 7.4 persons and the average yearly growth is 3.5% (CSO, 2000).

Population data during the last half of the 20th century are given Table 2.4 and depicted in Figure 2.3. A striking picture can easily be caught from this information. While, the world

population has merely doubled during the last century (UNFPA, 2000) the population of Yemen has increased four-fold during half a century. Such a population increase in a resource-poor country introduces a real challenge to economical and social development. The estimated average population growth rate of 3.7% is one of the highest in the world and an indicative of uncontrollable population growth. It is anticipated that the population will double in less than two decades (before year 2020). The consequences of such uncontrollably increasing population are obvious. Yemen is ranking very low in terms of human resource development indicators. It is one of the least developed countries in the world, and comes last in the list of the Arab League's State, not counting the war-torn Somalia!!

Table 2.4: Increase of the population during the time of 1950 to 1997

Items	1950	1975	1980	1986	1990	1994	1997	2000
Population (million)	4.3	6.9	8.1	9.8	12.2	15.8	16.5	18.3
% population Growth Rate	1.9	3.3		4.1	3.7	3.5	3.5	

Source: Compiled form Bamatraf, et al. 1996, Census 1994, and statistical Yearbooks, 1997 and 2000

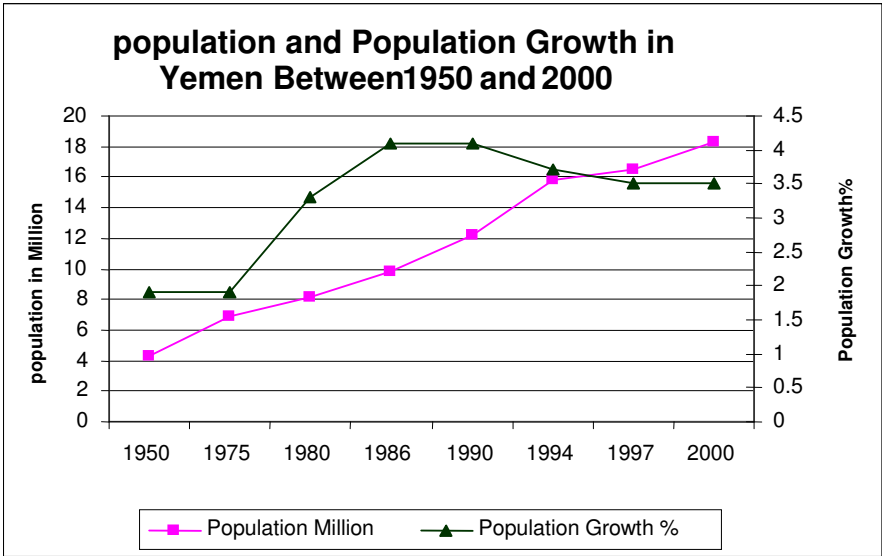


Fig. 2.3: Population and population growth in Yemen between 1950 and 2000

2.4.2 Demand on food

Yemen from the middle of 70s of the 20th century became under stress of shortage of food production, because of the low crop production and the increase of the population together with the migration of the male from the countryside (the villages where the agriculture land used to produce the food) to the cities and to the neighboring oil countries in Gulf State and Saudi Arabia. This incident pushed the country to increase the imported foodstuff and other requirements.

Food crop production is affected by water as a limiting factor, in countries like Yemen which is mostly dependent on rain to grow food crops to cover the demand on food. And with population growth, demand on food increased accordingly. It is the challenge to people in Yemen to eat from local production or not. Looking to Table 2.5, the planted area of food crop has decreased by 46% in the period between 1970 and 2000 while production increased 48% in the same period due mainly to introduce new technology to improve vertical production especially for vegetable and fruit production per unit area. However, population increased in the same period by 266%. Sequences challenges of population growth is the food security, in which, government must provide it for all people either from local production and/or from import.

Table 2.5: Food crop area, production, population, agricultural production/capita and change % (per capita, production and population) during the last 30 years

Year	Planted Area 1000 ha	Total production 1000 Tons	Total Population 1000	Yield t/ha	Agriculture Production Kg/Capita	Change %		
						Per Capita	Production	Population
1970	1492	1418	5,000	0.95	284	--	--	--
1980	961	1413	8,100	1.5	174	- 39	-1	+62
1990	1003	1752	12,200	1.8	144	- 17	+24	+51
2000	828	2101	18,300	2. 5	115	- 20	-20	+50

Source: Compiled from Table 2.3

Because of the flow of remittance from migrants to the country, government had subsidized imported food commodities such as wheat, flour, rice, sugar and so on. The subsidy on the imported foodstuff has advantages (in short run) and disadvantages in long run on economy of the country.

The advantages of subsidy are, the commodities were available in the market. So families can get it any time especially for these who moved from villages to the cities seeking for better life far from rural life with working in agriculture land. The other advantage is that it covers the increase of the demand, which coincide with increase of the population. While the disadvantages are, people get it easy to buy imported food and they become dependent on it, as it is cheaper and available in the market. Even the families who used to produce their own food stuff from their land become dependent on the imported food as it is cheaper than that they produce with effort, so the production of the land decreased because the effort that applied to the land become less. The other disadvantage of the subsidy is that it helped to expand of Q'at on food crop land. The farmers change their attitude from production of food crop to production a stimulant plant (Q'at). It becomes the most important cash crop selling in the market and provides cash for farmers to buy their food and other needs from imported commodities in the market. The other disadvantages are, attrition of country budget, subsidy did not reach the poor people,

consequence the corruption due to resell subsidy food in black market and re-export it to neighboring countries, support the exporter rather than local farmers and deterioration of local food production, in turn, it caused migration of people from agriculture area to cities, deteriorating of resources (land, water) and increased poverty. According to Hashim, 1999, Yemeni consumption changed partly due to the incorporation of Yemen in the world market and the introduction to a cash economy, in which imported food comprised the major portion of Yemeni food; even though bread made from maize or other crops, especially in cities has disappeared. Also I observed in the Q'at area, imported wheat became the main source of daily diet. Wheat imported increased rapidly from 296,000 tons in 1980 to 1.2 million tons in 1995 due to high rate of population growth and return of 800,000 immigrants from the Gulf State after the second Gulf war (Hashim, 1999). He added that the wheat production dropped to lowest levels, 363, 373 and 418 thousands tons in 1983, 1984 and 1985, respectively, where the median production of wheat was 932 and 644 thousands ton in the 1970s and 1980s respectively. However, the wheat production did not and will not reach to that values, because the production in 2000 valued 142 thousands tons with the highest yield (1.6 t/ha) Table 2.3.

The problem of subsidy will continue in Yemen economy until wise policy take place to reform local food production. Table 2.6 and Fig. 2.4 show examples of impact of imported subsidized food during 1990 to 2000 in which cereal's local production covered 40% of consumption in 1990, decreased to 27% in 2000, due mainly to increase of population and return of immigrants after the second Gulf war, low investment in food crop production and increasing investment in cash crops such as fruits, vegetables and Q'at. In which, Yemen reach self-sufficiency on vegetables and fruits, and then exported the surplus. However, vegetables and fruits cultivated under well irrigation or with supplementary from well irrigation, which increased stress on natural resources. Local production of wheat is not enough to cover increasing demand because it becomes the main source of the bread. It is covering approximately 1% of consumption. In which, imported wheat including flour fluctuated between 1990 with 1.03 million tons, increased gradually to 2.1 million tons in 1998 and decreased to 1.5 million tons in 2000 (MAI, 1992, 1995 and 2001).

Table 2.6: The crop production, export, import, in 1000 tons and % of consumption that covered by local production from 1990 to 2000

Year	Cereals				Vegetables				Fruits			
	Prod	Export	Import *	Prod. Cover Consm. %	Prod	Export	Import	Prod. Cover Consm. %	Prod	Export	Import	Prod. Cover Consm. %
1990	841	2	1250	40	896	5	12	99	313	5	13	98
1991	491	18	1657	23	642	1	25	96	316	0.1	18	95
1992	886	4	1104	45	681	0.3	10	99	336	1	5	99
1993	919	0.4	1280	42	731	1	16	98	363	3	20	96
1994	870	3	1459	37	646	1	23	97	361	1	18	96
1995	881	4	1524	37	669	2	3	100	402	4	15	97
1996	731	0.05	1921	28	703	0.02	13	98	391	6	9	99
1997	712	1	2041	26	718	0.02	26	97	469	81	10	118
1998	911	6	2332	28	747	14	4	101	555	9	12	99
1999	758	5	2236	25	760	34	2	104	579	28	14	102
2000	739	24	1996	27	775	28	7	103	591	41	19	104

Sources: Compiled from CSO and MAI, 1992, 1996, 2001. * Include Rice

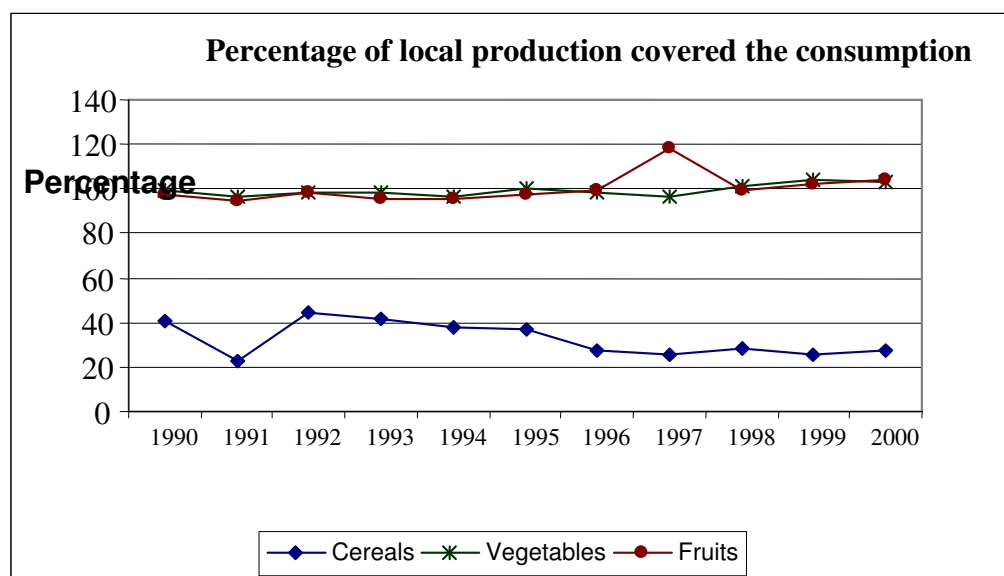


Fig. 2.4: Percentage of local production covered the consumptions