Chapter 2
Realizing Food Security Through Sustainable Agriculture in the Republic of Yemen: Implications for Rural Extension

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2.1 Introduction

The Republic of Yemen with its coordinates 12° and 17°N Latitude and 43° and 56°E Longitude, located in Western Asia, lies in the southwest Arabian Peninsula. The country has rugged surface features composed of mountains, hills, plateaus, plains, and valleys (FAO 2009). Spreading over an area of 536,000 km^2, comprising many islands in the Red Sea and Arabian Sea. The country is bordered by Saudi Arabia to the north, Oman to the east, the Arabian Sea to the south and the Red Sea to the west. The country has been divided into 20 governorates, which are further divided into districts.

With Yemen's estimated population of 26.2 million (World Bank 2015), about 80% live in the rural areas (IFAD 2015). Agriculture is the prime sector in economic development, contributing about 17.5% towards GDP (NASS 2012) and the main source of employment accommodating almost 54% of the population (FAO 2009). Yemen is a low-income country and GDP amounts to USD 33.76 billion with GDP per capita averaging USD 1361 in nominal terms (World Bank 2011; IFAD 2013). Playing an important role in the economy, agriculture sector generates about 20% of

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the total internal revenues (FAO 2009). In addition, the sector creates significant employment opportunities in the other sectors like: transport, processing, and trading that may reach to 54% (Irin 2007; NASS 2012). Agriculture also plays an important role in food security, improves the trade balance and results in an integrated rural development. In addition, the agriculture sector helps in stabilizing the population balance by reducing internal migration and mitigating the resultant social and economic problems (NASS 2012).

Farming in Yemen, in spite of harsh and difficult environment, has a long history of contributions to the rural economy. Despite numerous constraints, the agriculture sector has considerable potential to produce enough food to feed its people and make it an engine of growth, if farming systems are re-introduced to the farmers with some improvements.

The purpose of the chapter is to identify the problems and issues faced by the farming systems and discuss the possible role of agricultural extension to elevation crop productions. In the light of the analyses of the identified shortcomings, various viable remedial measures to improve the farming systems and the national extension service have been presented. Also, we anticipate that sustainable agriculture backed by an efficient extension service could help enhance crop yields, improve food situation, and ensure food security in the country.

2.2 An Overview of Agriculture Sector in Yemen

Agriculture is the key sector, which can ensure food security and also be the main source of income for the majority of people. The sector helps to improve the trade balance and promotes integrated rural development. In addition, agriculture sector helps in stabilizing and lowering rural migration to the cities, thus mitigating resultant social and economic problems. About 80% of the population lives in rural areas (IFAD 2015) and some 22 million inhabitants residing in rural areas are involved in agriculture or agricultural related activities (FAO 2009). According to the recent FAOSTAT estimates, about 65% population lives in the rural areas as depicted in Fig. 2.1. Information regarding the evolution of population and labor force size, agricultural growth has been presented in Tables 2.1 and 2.2.

Semi-arid environment and varied topographic features of the country provide favorable conditions for a wide variety of crops to grow. The total agriculture area is estimated at 1668, 858 ha, of which, 1,132,910 ha (68%) is cultivated while the uncultivated area is 535,948 ha (32%). However, sorghum, maize, millets, pulses, wheat, barley and millions of mango trees are sustained by only 3% arable land (FAO 2009). Vegetable crops are raised on the fertile soils in many agro-ecological zones of the country on an estimated area of about 57,000 ha. Potato and tomato crops cover almost 50% of this area. More than 20 species of vegetables are grown mainly under irrigation system. The vegetable cultivation, including several exotic varieties on the irrigated areas are expanding and the ground water depletion is also the main cause of this kind of expansion (FAO 2009). The growth rate in agricultural

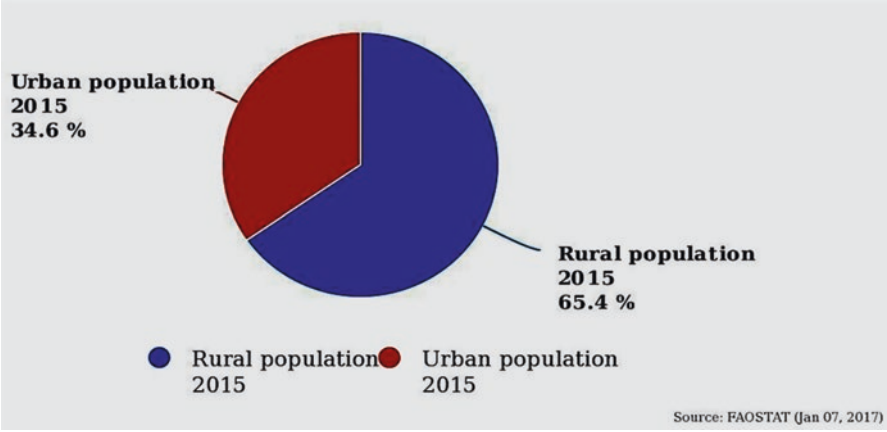


Fig. 2.1 Rural and Urban Population in Yemen 2015. (Source: FAO 2016)
Available at: http://www.fao.org/faostat/en/#country/249

Table 2.1 Evolution of population and labor force size

	Size [millions]				Annual growth rate [%]		
	2000	2005	2010	2015	2000–2005	2005–2010	2010–2015
Total population	17.52	20.14	22.76	25.54	2.83	2.48	2.33
Total labor force	3.91	4.78	5.64	6.57	4.1	3.36	3.1
Labor force in agriculture	1.87	2.09	2.19	2.21	2.25	0.94	0.18

Source: FAOSTAT (2015)

Table 2.2 Evolution of population and labor force composition

	Share [%]				Annual growth rate [%]		
	2000	2005	2010	2015	2000–2005	2005–2010	2010–2015
Rural population [% of total population]	73.73	71.06	68.26	65.35	−0.73	−0.8	−0.87
Labor force in agriculture [% of total labor force]	47.85	43.84	38.81	33.69	−1.74	−2.41	−2.79
Females [% of labor force in agriculture]	33.99	38.97	40.21	40.53	2.77	0.63	0.16

Source: FAOSTAT (2015)

sector averaged only 2.4% per year, compared to the population growth rate of 3.7%, one of the highest in the world. The demand for vegetables and fruits are met through indigenous productions but only 40% of the domestic demand for grains (FAO 2009).

The country that once used to be self-sufficient in cereals now imports 75% of its food requirements to fill the gap in local food production within the country. In the past, Yemen was famous for producing good quality coffee being the main cash crop of the past now has been replaced by qat, a mild stimulant regularly chewed by about 70% of Yemeni men.

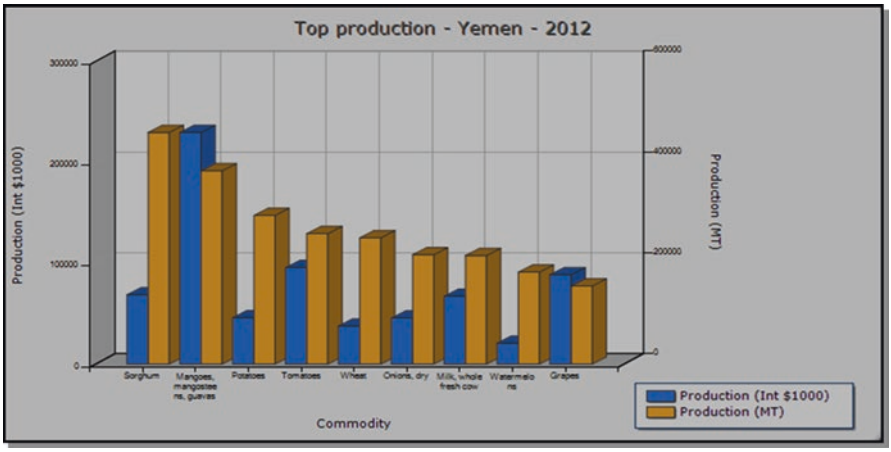


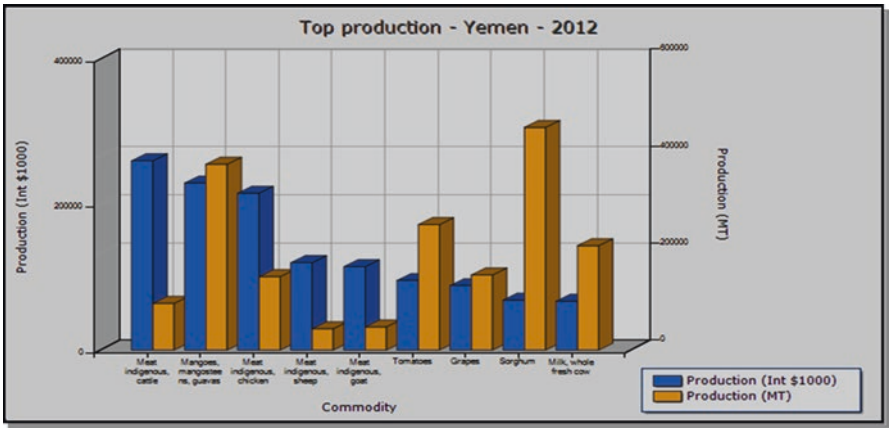
Fig. 2.2 Top production of various agricultural commodities and their respective values. (Source: FAO 2015)
Available at: http://faostat.fao.org/site/339/default.aspx

Agriculture sector is negatively impacted and not in a position to realize its potential due to lack of resources, and external factors such as climate change, social conflicts, and lack of security. On the other hand, most of the farmers are poor and survive at subsistence level and rural women, though play a significant role in farming, have not yet come into mainstream development. The country needs a development plan, and a long-term agriculture policy to achieve food security and reduce rural poverty. According to a comprehensive study by the International Fund for Agricultural Development (IFAD 2009), poor agricultural production could be a result of low and weak technological base, resulting in modest annual growth of less than 4% between 2003 and 2007.

However, the agricultural productivity, particularly those of crops and livestock is 50% lower as compared to the other Middle Eastern countries placed in similar environments. A comprehensive scenario on agriculture and its allied components is highlighted in Figs. 2.2, 2.3, and 2.4 and Tables 2.3 and 2.4.

The agriculture sector consumes up to 90% of available water in Yemen (NASS 2012). A significant volume of water estimated to be 50–65% is being wasted due to inefficient irrigation systems. Low agricultural productivity, water scarcity, climate change, insufficient off-farm economic and employment opportunities, high rural population growths together with high dependency ratios constitute critical negative factors affecting rural areas with increased rural poverty. Limited resources, especially water, and lack of access to basic services are major factors for migration from rural areas especially mountainous villages and settlements are being increasingly abandoned in search for employment opportunities in the urban areas (IFAD 2013).

Most farms are extremely small with typically low household farm incomes (GAFSP 2013). Unlike most of the world, economic dependence on agriculture in Yemen has been growing because of reduced opportunities in the industrial and



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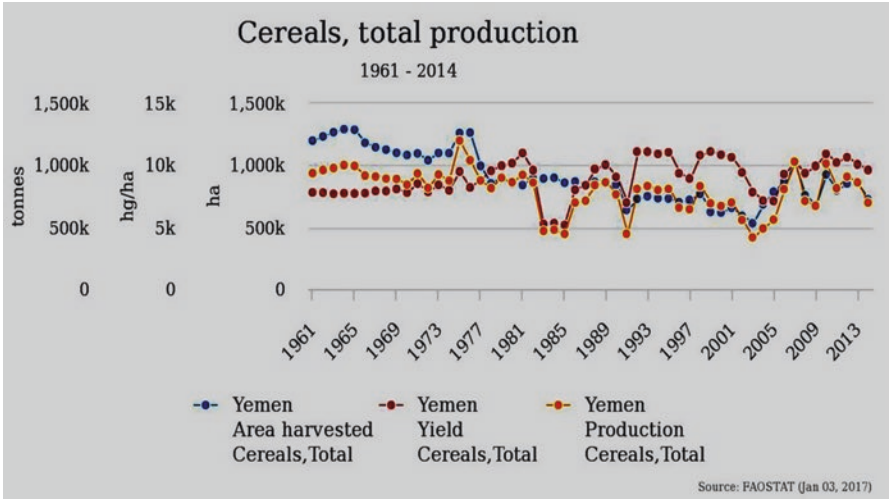

Fig. 2.4 Total production of cereals from 1961 to 2014. (Source: FAOSTAT 2016)
Available at: http://www.fao.org/faostat/en/#country/249

services sectors. The agriculture sector has realized its potential, registering annual growth of over 5% for grains, and impressive increases in coffee and honey production. As depicted in Table 2.4, FAO (2016) reported that the total cereal production was estimated at 653,000 tonnes, including 300,000 tonnes of sorghum and 165,000 tonnes of wheat, however both the cultivated land and agricultural production declined as compared to 2014 (FAO 2016). Despite the negative effects of scarcity of resources, the potential exists to achieve significant gains in agricultural

Table 2.3 Production top 20 food commodities (MT) with their respective values in Int. $1.000

Rank	Commodity	Production (MT)	Production (In Int $1.000)
1	Meat indigenous, cattle	96,302	260,149
2	Mangoes, mangosteens, guavas	383,107	229,545
3	Meat indigenous, chicken	151,402	215,659
4	Meat indigenous, sheep	44,088	120,043
5	Meat indigenous, goat	47,850	114,653
6	Tomatoes	258,654	95,589
7	Grapes	154,869	88,526
8	Sorghum	459,241	68,710
9	Milk, whole fresh cow	215,321	67,193
10	Eggs, hen, in shell	63,420	52,600
11	Potatoes	294,686	45,954
12	Onions, dry	216,739	45,522
13	Wheat	250,264	37,741
14	Tobacco, unmanufactured	23,251	37,033
15	Bananas	127,468	35,899
16	Chick peas	58,560	28,347
17	Dates	55,181	28,181
18	Oranges	122,000	23,577
19	Milk, whole fresh sheep	56,637	22,055
20	Coffee, green	19,828	21,302

Source: FAOSTAT (2015)
Available at: http://faostat.fao.org/site/339/default.aspx

Table 2.4 Production of top three crops 2014–2015

Yemen cereal production				
2010–2014			2015	Change
Average		2014	Estimate	2015/2014
	000 Tonnes			Percent
Sorghum	432	342	300	−12
Wheat	234	192	165	−14
Millet	86	74	80	8
Others	108	93	108	16
Total	860	701	653	−7

Note: percentage change calculated from unrounded data
Source: FAO/GIEWS country cereal balance sheets
Available at: http://www.fao.org/giews/countrybrief/country.jsp?code=YEM

productivity (NASS 2012). The country has a strong history of producing a wide variety of agricultural products in difficult environments to support the agriculture sector and the rural economy. Significant hikes in agricultural productivity are possible, even if resource constraints limit these gains. In this chapter, it is argued that the country needs to identify the constraints resulting in lower yields. The most important issues and challenges are discussed in the following sections.

2.3 Challenges to the Agriculture Sector

Agriculture in Yemen faces numerous constraints namely stressed land, scarce water resources, expansion in cultivation of qat cultivation on fertile and productive land, inadequate marketing systems, human resources with low education and working ability, lack of infrastructure and production technologies, and insufficient availability of inputs. These constraints prevent agriculture sector from making significant contributions to rural incomes, national GDP, and addressing the trade imbalance in food items. According to FAO, agriculture sector in Yemen is beset with numerous constraints (Box 2.1). Yemen is essentially a rural economy and agriculture sustains 80% of its population. Development indicators for the country are presented in Table 2.5 (Annex).

2.3.1 Water Resources

Lack of water is a crucial issue in Yemen. Half of the country does not have access to adequate water and sanitation; as such, water is already a cause of conflict within the country. Agriculture uses more than 90% of the country's scarce water resources. Most of the crops are that of qat, a non-food crop. Though the per capita average share of renewable water resources is one tenth of the average in most Middle Eastern countries and one 50th of the world average yet, even at low usage rates, demand increasingly exceeds fresh water supply (USAID 2016). Compared with an average of 1250 m^3/cap/year for the Middle East and North Africa, availability of 150 m^3/cap/year makes Yemen one of the most water deficit countries. The level is less than one tenth of the water threshold i.e. 1700 m^3/capita/year. In highland governorates, less than 20% of communities have access to safe drinking water from public water supply systems whilst 60% of settlements rely on unprotected springs and wells and 20% on cisterns, streams and tanks. Total water demand which stands at 3400 million m^3 per year exceeds renewable resources of 2500 million m^3 per year, thus leading to a steady decline in groundwater levels, varying between 1 m/year in the Tuban-Abyan area and 6–8 m/year in the Sana'a basin. The public supply of water, where available, is unreliable and inconsistent (IFAD 2013) (Fig. 2.5).

Water shortage for irrigation is the most serious problem preventing agriculture from realizing its potential in the country. Rains and groundwater are prime water sources (FAO 2009). The problem is getting aggravated, as the renewable water resources are finite and limiting on daily basis and inadequate to meet rapidly but ever-increasing demand. In the absence of any perennial river in the country, groundwater being the only reliable resource is supporting the major economic activities, including agricultural production. The current level of depleting groundwater extraction in the country greatly exceeds recharge in most of the aquifers, especially in northern areas and the inter-mountain plains, including Sana'a basin. Over-pumping has caused a marked decline in water levels and has deteriorated the water quality as well as it undermines the sustainability of the resource base (NASS 2012; IFAD 2013).

Box 2.1: Problems and Issues Faced by Agriculture in Yemen

Among the wide range of constraints affecting agricultural production, the most prominent are:

- Renewable water resources are finite and limited, while demands for water are growing;
- Land is a limited resource;
- Excessive land fragmentation of agricultural land-holdings on mass scale;
- Productions from the traditional subsistence agriculture and other prevalent agricultural systems are decreasing, particularly on terraces due to the growing migration of male workers;
- Wide spread rural poverty among the farmers, practicing subsistence farming;
- Lack of coordination among the various agencies engaged in the agricultural development and rural infrastructure development;
- An uncoordinated development of rural infrastructure;
- Lack of infrastructure facilities;
- Lack of production technologies;
- Low productivity, resource constraints;
- Insufficient availability of inputs;
- Lack of credit facilities;
- Lack of funding and limited support from the government to the farmers;
- Previously launched development projects were unable to meet farmers' expectations;
- Climate change and environmental issues;
- According to the Global food security index 2016 (an annual measure of the state of global food security) Yemen ranked 100th among the 113 countries with the score of 34.0. FAO (2016) reported that more than half (51%) of the population (14.4 million Yemenis) are food insecure. Food insecurity remains a major challenge;
- Key role played by rural women in agriculture remains neglected and is largely unacknowledged; and have not yet come into the mainstream development;
- Agriculture sector has not realized its full potential due to lack in export opportunities;
- Absence of quality and safety standards, hindering farmers to get premium prices for their produce and products;
- Inadequate marketing systems, limited marketing opportunities for the small farmers, provided by traditional retail and wholesale markets,
- Lack of farmers' associations and organizations result in challenges for the farmers at all levels in marketing their produce;
- Qat is displacing coffee and other food crops due to its increasing production that is competing for limited groundwater resources (Source: FAO 2009, 2016; NASS 2012; GFSI 2016)

Table 2.5 Development indicators of Yemen World Bank 2015 (Annex)

Indicator	2013	2014	2015
Population, total	25,533,217.0	26,183,676.0	–
Population growth (annual %)	2.6	2.5	
Surface area (sq. km)	527,970.0	527,970.0	
Population density (people per sq. km of land area)	48.4	49.6	
GNI, Atlas method (current US$)	33,318,506,441.7		
GNI per capita, Atlas method (current US$)	1300.0		
GNI, PPP (current international $)	93,320,014,470.7		
GNI per capita, PPP (current international $)	3650.0		
Life expectancy at birth, total (years)	63.6		
Mortality rate, under-5 (per 1000)	46.0	43.8	41.9
Prevalence of underweight, weight for age (% of children under 5)	39.9		
Immunization, measles (% of children ages 12–23 months)	78.0	75.0	
Primary completion rate, both sexes (%)	70.1		
Gross enrolment ratio, primary, both sexes (%)	101.0		
Gross enrolment ratio, secondary, both sexes (%)	49.2		
Gross enrolment ratio, primary and secondary, gender parity index (GPI)	0.8		
Prevalence of HIV, total (% of population ages 15–49)	0.1	0.1	
Forest area (sq. km)			
Annual freshwater withdrawals, total (% of internal resources)	169.8		
Improved water source (% of population with access)			
Improved sanitation facilities (% of population with access)			
Urban population growth (annual %)	4.3	4.2	
GDP at market prices (current US$)	35,954,502,303.5		
GDP growth (annual %)	4.2		
Inflation, GDP deflator (annual %)	7.9		
Time required to start a business (days)	40.0	40.0	40.0
Mobile cellular subscriptions (per 100 people)	69.0	68.5	
Internet users (per 100 people)	20.0	22.6	
High-technology exports (% of manufactured exports)	0.4		
Overall level of statistical capacity (scale 0–100)	52.2	55.6	55.6
Merchandise trade (% of GDP)	60.1		
External debt stocks, total (DOD, current US$)	7,646,774,000.0	7,710,440,000.0	
Net migration			
Personal remittances, received (current US$)	3,342,500,000.0	3,350,500,000.0	
Foreign direct investment, net inflows (BoP, current US$)	−133,570,895.6	−738,028,978.9	
Net official development assistance and official aid received (current US$)	1,003,530,000.0		

Source: World Bank (2015) (Available: http://databank.worldbank.org/data/reports.aspx?source=2&country=YEM&series=&period)

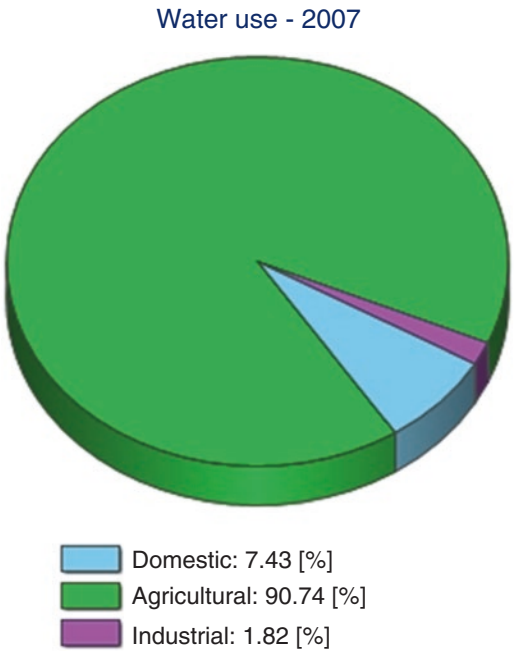

Fig. 2.5 Water use by various sectors in 2007. (Source: FAO 2015) Available at: http://faostat3.fao.org/home/E

Yemen is an arid country and its agriculture sector consumes almost 90% of the potable water, and does not actively promote sustainable water saving techniques. Urban supplies and agricultural production have been under increasing threat from unregulated and widespread use of pumped irrigation supplies by the private sector. The situation calls for immediate regulatory measures to reverse the trend in over-exploitation of water resources. Various strategies have been drafted and are in place, however, the measures taken so far are quite insufficient to make agriculture sustainable and ensure sustainability of water resources of the country. Almass and Scholzb (2006) maintain that Yemen's agriculture sector and its water resources are in real stress. Almost half of the population, about 25 million masses, do not have access to safe water and sanitation (USAID 2016) (Fig. 2.6).

2.3.2 Rainfed Agriculture

Rainfall and underground water resources like wells and springs are major sources to sustain agriculture on roughly 77% of the total cultivated area. Just about half of the total rainfed area receives rainfall less than 350 mm, which could be considered below the minimal amount needed for rainfed agriculture (FAO 2009). While the development of rain-fed agriculture has not yet received as much attention as it deserves, the pressure on groundwater resources has been ever increasing. The recharge of water is far less than the water being pumped out. The groundwater consumption for agricultural purposes is as high as 70%, and according to an estimate

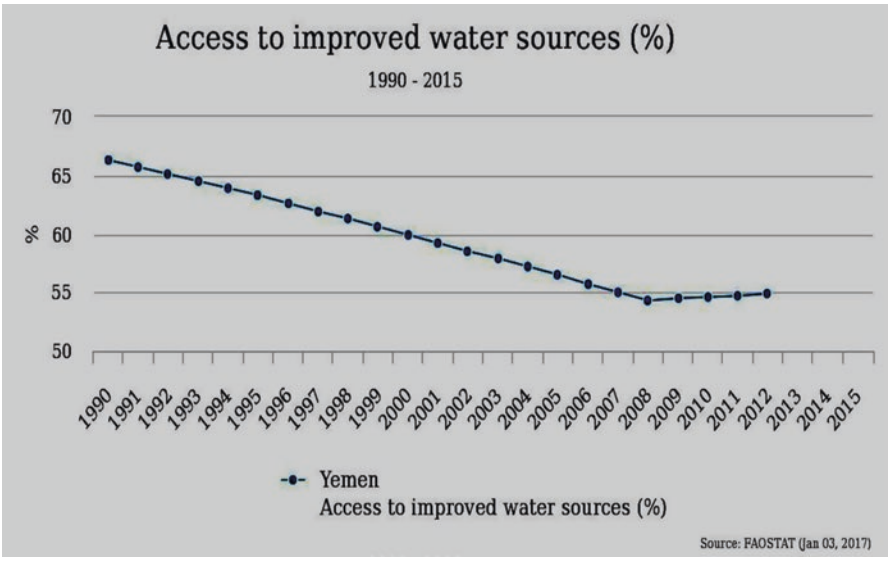

Fig. 2.6 Access to improved water sources (%) 1990–2015. (Source: FAO 2016) Available at: http://www.fao.org/faostat/en/#country/249

over 30% of that consumption goes into the cultivation of qat alone (New Agriculturalist 2010). Adaptive research on the rainfed areas can help sustaining agricultural crops by identifying new varieties and agronomic packages for producing grain and fodder crops that could utilize less water, but are more drought resistant and greater salt-tolerant resulting in higher yields. However, to bring the ideas to the farmers, an aggressive extension program to disseminate information on high yielding varieties and appropriate agronomic techniques to boost production of rainfed grains and forages would be required.

Rainfed farming remains intrinsically risky enterprise due to the rising temperatures and declining, erratic and variable rainfall. In this situation, soil moisture conservation becomes even more important strategy to adapt, because if rains fail (and fail more frequently), crops will also fail, especially if within season spells of drought are prolonged. Supplemental and full irrigation can mitigate longer within season and inter-annual drought, but under climate change conditions, irrigation water supply will also be less secure (Hugh et al. 2011).

2.3.3 Poor Land Resources and Small Landholdings

Agriculture is dominantly practiced on small landholdings throughout Yemen, though tenants or sharecroppers cultivate many holdings. Almost 60% of all rural households have some land, although 44% have less than 1.0 ha; yet an average landholding size in coffee growing areas is as low as only 0.3 ha (IFAD 2009). A survey conducted by IFAD (2013) revealed that some 44% of rural households own

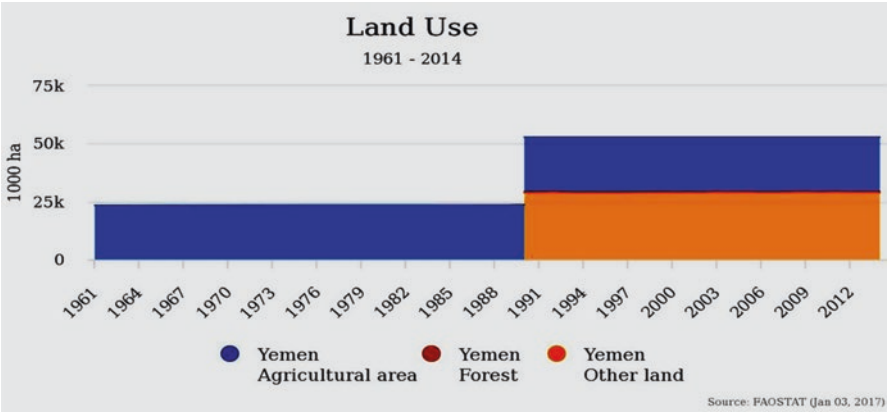

Fig. 2.7 Agricultural area in Yemen (1961–2014). (Source: FAO 2016)
Available at: http://www.fao.org/faostat/en/#country/249

farms with area less than 1.0 ha and about 40% of rural households are landless. Twenty-five percent of the landless farmers rear livestock, whereas almost 10% are fishermen and only 5% hold government jobs or are involved in off-farm income generating activities (Fig. 2.7).

In mountainous areas, agricultural fields consist of small terraces, and seemingly difficult slopes are farmed. In the coastal plains (the Tihama, which covers a vast majority of Hodeidah governorate), the land tends to be owned by large landholders; small farmers are interspersed among large farms and a majority of the rural poor work as casual daily laborers or as tenants and sharecroppers. Many of the landless poor find work on large commercial farms. Small-scale animal rearing is also practiced by the landless (IFAD 2013). However, limited access to land and smallholdings even with vivid increases in agricultural productivity cannot generate sufficient incomes for the farmers. Even though there are annual rainfall fluctuations, arable land in Yemen is spread over an area of 1.45 million hectares. Rainfed agriculture is being practiced on about 51% of cultivated land, some 30% is irrigated using groundwater pumped from wells, roughly 10% land is brought under cultivation by employing spate irrigation, about 6% land is irrigated from dams, and almost 3% lands receive irrigation through other sources (IFAD 2013) (Fig. 2.8).

An area of about 1.31 million hectares (94% of arable land) was cultivated in the year 2009–2010 out of which 52% were cereals, 13.8% were fruits and vegetables, 12.5% were fodder crops, and qat was grown on 11.7% of the land. Other cash crops (coffee, cotton, sesame, and tobacco) occupied 6.7% of the land while the legumes were only 3.3%. About 20 million hectares was kept as a grazing land. Four hundred and twenty thousand hectares was irrigated with groundwater resources, almost 11 times more than in the 1980s i.e. 37,000 ha. Notably rainfed cultivated area reduced to about 695,388 ha, while in the 1980s, it was about 1.06 million hectares. The remainder was flood/spate irrigated (IFAD 2013). The recent FAOstat, 2016 estimates on lands and their utilization indicate that permanent crops, forests. Arable

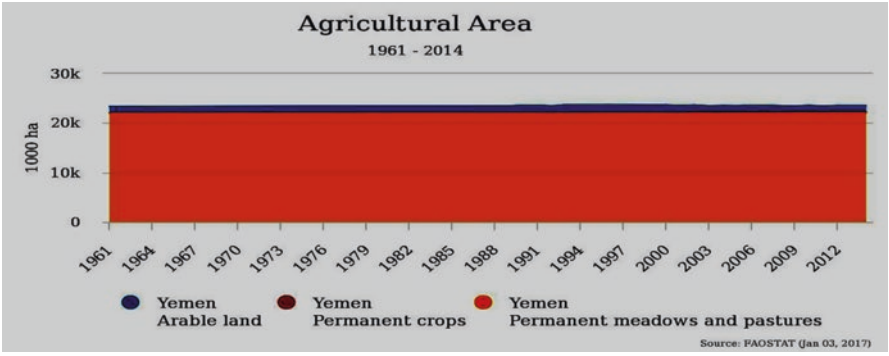

Fig. 2.8 Agricultural area in Yemen (1961–2014). (Source: FAO 2016)
Available at: http://www.fao.org/faostat/en/#country/249

Table 2.6 Land use in Yemen in 2014

	(Area in 1000 ha)
Country area	52,797
Land area	52,797
Agricultural area	23,546
Arable land and Permanent crops	1546
Arable land	1248
Permanent crops	298
Permanent meadows and pastures	22,000
Forest	549
Primary forest	0
Other naturally regenerated forest	549
Planted forest	0
Other land	28,702
Area of arable land and permanent crops under protective cover	0.29
Total area equipped for irrigation	680

Source: FAO (2016)
Available at: http://www.fao.org/faostat/en/#country/249

land, permanent meadows and pastures, and other lands cover 0.6%, 1.0%, 2.2%, 41.7% and 54.5% respectively (Table 2.6).

2.3.4 Desertification and Agriculture

Desertification affects around 30 million hectares of the land accounting for over 50% of total land. The hazards of mounting desertification are quite high. Desertification is caused by water erosion, overgrazing, depletion of tree cover,

Table 2.7 Types of land degradation

Type of land	Area (Ha)	Area (sq km)
Desert land	4,856,897	48,569
Chemical degradation of land (Saline agriculture land)	37,090	371
Sand dunes	5,815,937	58,159
Land degraded by heavy winds erosion	475,246	4752
Land degraded by light winds erosion	102,943	1029
Physically degraded lands	12,717	127
Rocky land	28,196,804	281,968
Mountainous terraces	661,504	6615
Naturally stable land (forests and trees)	272,154	2722
Land affected by water light erosion	643,960	6440
Land affected by water medium erosion	1,846,813	18,468
Land degraded by water heavy erosion	2,579,835	25,798
Wetlands (Sabkha)	48,346	483

Source: Millennium Development Goals Needs Assessment, Yemen Country Report; Yemen AREA –ACSAD (2002)

abandonment of terraces, changes in socioeconomic factors and farming practices that determine unsustainable practices for land cultivation (ICARDA 2012). It is estimated that 95% of Yemen's agricultural land remains at risk of deterioration, threatening the government's goal of attaining food self-sufficiency. At present, Yemen imports about 75% of its food, according to government statistics (Irin 2007).

Internal migration from rural areas to cities adversely affects agricultural production, which in future, may result in food insecurity. According to a study, about 85% of Yemen's agricultural land is deteriorating due to water shortages, partly caused by the widespread cultivation of Qat, which requires a lot of water, adding to the growing threat of desertification (Irin 2007). Good quality fertile lands, which account for about 13.6% of the total arable land, are shrinking (Irin 2007).

Models suggest that temperatures in Yemen will steadily rise, and that there is likely to be an increase in variability and intensity of rainfall. Yemen is already experiencing higher incidence of floods. Climate change and variability will thus add to other natural resource challenges to create a need for a wide range of adaptive measures (Table 2.7).

2.3.5 Food insecurity

Yemen is ranked as the 11th most food-insecure country in the world, with one in three Yemenis suffering from acute hunger (IFPRI 2011). Over half the rural population (51%) is food-insecure as compared to 27% of the population in urban areas (CFSS 2012). According to the National Agriculture Sector Strategy (NASS) (2012), some 24% of the households are food insecure. In 2012, about 46% of

Yemenis – around 10.5 million people – did not have adequate food and almost half of all households (45%) are now buying food on credit. Some 6.4 million food insecure masses (37% of the total rural population) live in rural areas. According to a UN report (2015), about 13 million people in the country are food insecure.

In another estimate by IFAD (2015), almost 12.9 million people across the country are food insecure, out of which about 6.1 million are in need of food on Emergency basis, while 6.8 million were placed in crisis situation. The level of food insecurity increased by 21% compared to 2014. The factors like disturbance of markets, diminishing employment opportunities and declining rural livelihoods, can further deteriorate the food security situation if external conflicts and internal insecurity continue to persist.

Overall, 13% of children under 5 are acutely malnourished. Due to chronic malnutrition among children, nearly 60% of children are suffering from stunted growth and severe (life threatening) stunting affects one third of all children in the country. Stunting growth is predominantly affecting two children out of three in rural areas. The poor mountain agriculture areas of the highlands are unsuitable for agriculture and two thirds of Yemenis living on the fringes of mountains are food insecure (IFAD 2013).

2.3.6 Food Imports

Farmers on small landholdings are unable to feed the ever-increasing populations of the country. Therefore, the country is very much reliant on food imports, which account for nine-tenths of its total food requirements (UNDP 2015). Yemen is largely dependent on imports to satisfy its domestic consumption requirement for wheat, the main staple (FAO 2015).

However, the National food security depends on the financial capacity of government to import food commodities to compensate for production shortfalls (IFAD 2013). Almost 80% of cereals consumed in the country are being imported to meet food requirements (Government of Yemen 2013). Yemen imports 70% of all cereals, 90% of wheat and 100% of rice to feed its requirements (IFAD 2013). The wheat import dependency is about 95% and in the last 5 years, an average of 2.8 million tonnes per annum of wheat was imported annually out of a total domestic wheat utilization of about 3 million tonnes.

According to recent FAO statistics, the import requirement for cereals in the 2014 was estimated at about 4.5 million tonnes, including 3 million tonnes of wheat, 0.7 million tonnes of maize and 0.4 million tonnes of rice. This compares with 4.4 million tonnes of cereals imported in 2013 (GIEWS 2015).

However, due to the ongoing conflict and the resultant restrictions, only 15% of the pre-crisis volume of imports is reaching Yemen. The situation has largely affected business activity and the reaching of goods into the country. Consequently, some 75% businesses are struggling to maintain their regular provisions and supplies (UNDP 2015) (Fig. 2.9 and Table 2.8).

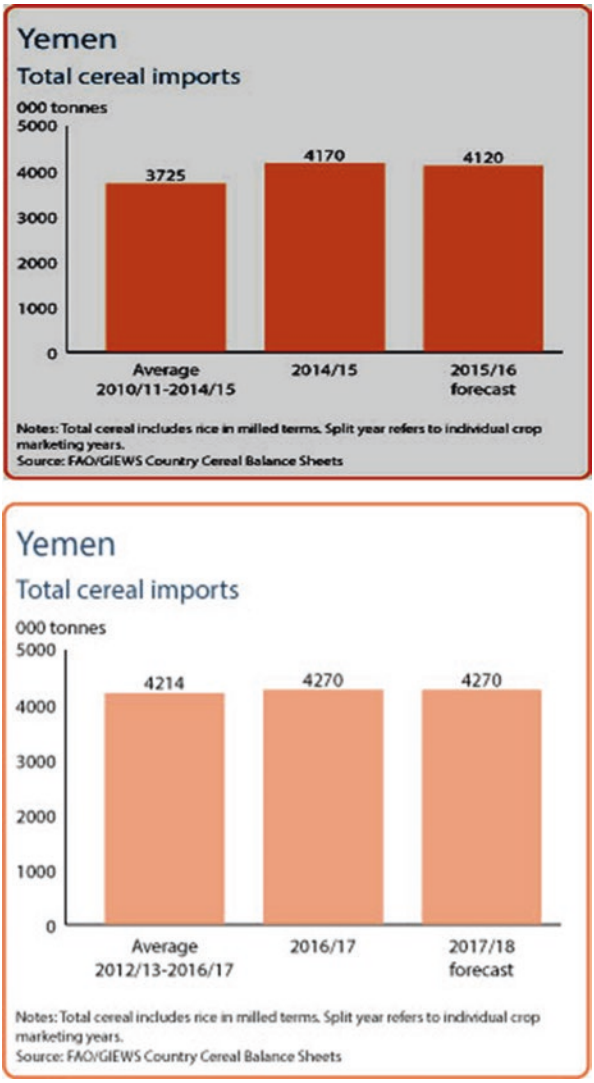

Fig. 2.9 Imports of top three crops 2014–2015 (Source: FAO 2016)
Available at: http://www.fao.org/giews/countrybrief/country.jsp?code=YEM

2.3.7 Gender Issue and Women Participation

Yemen faces an issue of high gender inequality. Strict gender segregation is a way of life in the country (IFAD 2013). With a value of 0.128, women in Yemen rank at 75th position among the 75 countries in terms of empowerment (IFAD 2007). Women grossly contribute to farm labor and take care of small livestock herds. In addition, they are in charge of household activities (cooking, fetching water,

Table 2.8 Imports of top ten commodities – their quantity (t) and value [1000 USD] 2011

	Commodity	Quantity [t]	Value [1000 USD]
1	Wheat	2,686,857	961,895
2	Sugar refined	456,013	353,866
3	Maize	438,635	153,262
4	Sugar raw centrifugal	207,857	159,677
5	Palm oil	152,410	155,811
6	Beverage non-Alc	144,323	58,790
7	Cake of soybeans	111,773	51,058
8	Fruit juice nes	85,027	Not available
9	Chicken meat	81,683	166,014
10	Pastry	56,685	Not available

Source: FAO, 2015 (Available at: http://faostat3.fao.org/browse/area/249/E)

collecting fuelwood, washing, child rearing etc.) In general, women are not recognized as farmers (except when left alone to manage the farm) and they do not have access to resources, inputs, and services (such as training, needed to strengthen their skills and increase their efficiency). Even though their share of work in the household and on farm is by far the most significant, women are not decision makers and are not fully involved in development programs, mainly in rural areas. However, the role of women, as an economically productive and effective force is slowly getting recognition. Women in rural areas are unable to fully participate in activities that are aimed at reducing disparity and empowering women. Several women NGOs, associations and advocacy groups have started working on the issue at local, national and regional levels (IFAD 2009, 2013).

2.3.7.1 Neglected Role of Women and Relation to Nutrition

Women have always played a vital role in Yemeni agriculture (particularly livestock) and this role has increased with male migration to the cities for work. However, women have inadequate access to the resources and services, therefore rural women deserve to be empowered to influence authorities and participate in decision-making. In fact, real development of agriculture and improvement in household food security and nutritional status is impossible without women's empowerment. Women empowerment can be enhanced through the inclusion of women households systematically in all committees, and by recruiting female agricultural extension staff.

2.3.8 Poverty in Yemen

Yemen is the poorest country in the Arabic Peninsula (IFAD 2013). While in 2008 about 40% of rural people were living below the national poverty line of USD 2 equivalent per day, the triple crises of recent years (food price crises, fuel price

crisis, and global financial crisis) increased the incidence of rural poverty to 48% by 2010. Following the political and social violence of 2011–2012, it is now estimated that rural poverty has increased to over 60%; which implies that as of today around 15 million rural people live in poverty and food insecurity. In addition, a large segment of population living marginally above the poverty line remains highly vulnerable to economic and natural disasters (IFAD 2013).

2.3.9 Malnutrition

In 2012, some 10.5 million people (46%) did not have enough food (NASS 2012). Yemen is faced with the issue of malnutrition as over 50% of children are chronically malnourished, and as high as 60% are stunted. Global acute malnutrition levels of over 30% were recorded in 2011. Based on Global Hunger Index calculated by the International Food Policy Research Institute (IFPRI), 2011, Yemen ranks among the ten hungriest countries of the world. Over 80% of food-insecure people are living in rural areas, and at the same time rural-urban disparity is escalating. The dwellers of the highland and mountainous areas are the most vulnerable as compared with the other areas of the country (IFAD 2013). Linkages between production, guidance and nutrition are of paramount importance. Combating malnutrition requires specific agricultural extension and educational initiatives, most appropriate of them include: creation of awareness on nutrition, nutrition-specific issues, school-food program, vegetable home gardens, backyard poultry etc. (NASS 2012; IFAD 2013).

2.3.10 Climate Change and Agriculture

Climate change models unanimously project that temperatures will increase across Yemen over the next few decades by levels higher than the projected global average.

While these models agree on temperature, they disagree on the direction of change in precipitation levels. Most of these models project a modest increase in precipitation, while others point to a reduction in precipitation.

The discrepancy is mainly attributed to the location of Yemen in the Inter-Tropical Convergence Zone (ITCZ) which has highly unpredictable climate patterns. It is however projected that climate change will drive up the variability of precipitation leading to more frequent and intense rainfall events and more extended droughts. These projected changes are generally expected to aggravate existing problems facing socio-economic development and present additional development challenges to international development agencies including IFAD.

In the absence of adequate adaptation measures, extreme rainfall events could cause devastating flash floods that erode fertile soils, destroy crops, buildings and

infrastructures and take lives of unprepared rural victims. They pose significant risk to the livelihood of rural communities – particularly the poor, women and the marginal communities.

Droughts will accentuate the severe water scarcity in Yemen and will have a detrimental impact on agriculture, particularly rain-fed agriculture which constitutes the economic mainstay for the majority of the rural population, reducing the area of viable rain fed land.

Recently Al-Kharasani (2014) conducted a study on climate at the Taiz meteorological station and analyzed the data that indicated an increase of 1.04 °C in maximum air temperature and 2.5 °C in minimum air temperature during the period from 1983 to 2013. Based on the findings of study, it is anticipated that climate change would affect the agriculture sector due of the change in temperature. Climatic data of both air temperature and rainfall has shown that the air maximum temperature has increased by 1.04 °C during the period from 1983 to 2013. This rise may cause drought in some areas resulting in the loss of some agricultural crops. The authors believe that the rise in temperature could be due to the increasing greenhouse gases in the atmosphere as a result of anthropogenic activities.

2.3.11 Qat: Rival of Food and Cash Crops

Qat (*Catha edulis*) is a recreational drug, a semi-narcotic plant. As a mild stimulant Yemenis chew its leaf for relaxation (IRIN 2012). It is cultivated on an estimated area of 154,000 ha that represents about 22.3% of irrigated area. The crop consumes almost 40% of the potable water. It is mainly cultivated in the highland where water scarcity is critical. Reducing qat production, and promoting water reuse of treated wastewater for irrigation could mitigate the water crisis. However, this is currently socially unacceptable (Almasa and Scholzb 2006).

Qat is a, favorite among the farmers for its ever-increasing demand and guaranteed marketing at lucrative price. The farmers even get indirect government subsidy on diesel used for pumping out the ground water. The government is taking measures to discourage the qat cultivation, because apart from huge water consumption, it has become a social problem, not to mention the increasing threat of food security as the land being used for qat cultivation could be used for growing food crops. So far, the success has been limited in convincing farmers to grow alternate crops.

Being a profitable crop, it is increasingly displacing food crops, and also utilizing limited groundwater. About one third of Yemeni agriculture is devoted to producing qat. Its production is profitable but replaces the production of food crops or export crops, and its consumption can be a social and health problem. However, it is also a mainstay of the rural economy in the highland areas where it is grown, with over 25% of farmers, including very poor ones, growing the crop. Farmers view qat as a powerful agent for bringing cash back from urban to rural areas. No doubt, qat has its role in the rural economy and poverty reduction, however strict implementation of appropriate measures would reduce, and ultimately phase out the crop to get rid

of the menace caused because of it. Farmers are to be educated to produce market-driven alternatives and other high value crops such as coffee and almonds instead of wasting scarce water resources on producing qat.

A report suggests that one in every seven working Yemenis is employed in producing and marketing qat, making it the second largest source of employment, exceeding even employment in the public sector (World Bank 2006). Qat cultivation is widely spread in the Sana'a Governorate. While the use of qat is acknowledged as a social plague, absorbing up to 28% of the earnings in low-income groups, its production and trade undoubtedly provides quick returns and employment (IFAD 2009). Irrigated qat production has been increasing at an annual rate of 3.5% between 1970 and 2006 and the associated increase of groundwater withdrawal has reached an estimated 837 million m^3/year (i.e. 84% of the renewable groundwater resources). In addition, uncontrolled pesticides are being used on qat, causing serious health hazards and contamination of water resources.

2.3.12 Political and Governance Issues

Following the events of 2011 and the dismissal of the previous regime, there has been a popular consensus on a 2-year transition period (2012–2014) and on a national dialogue conference to frame a new constitution and to prepare elections to a fully democratic government. Till date, this process has not met significant success. Yemen is experiencing governance issues due to political unrest. Although certain donor-funded projects are ongoing, the uncertainty prevails. Development activities cannot be carried out satisfactorily in the certain southern governorates due to security risk caused by militants.

2.4 Coffee Production

Yemen has long been famous for producing the best coffee in the world, known as Arabic coffee – *Coffee Arabica.* Yemeni coffee trade found great success because of its high and unique quality, which distinguished it from all other coffee types in the world. Yemeni coffee enjoys a highly lucrative market niche worldwide for its excellent quality (second only to Jamaica Blue Mountain) and receives higher price as compared to coffee produced in other countries (about twice the price of quality coffee from Costa Rica, Guatemala and Kenya). Some 11 countries import green coffee beans from Yemen on a regular basis due its better taste and premium quality (IFAD 2009). With the value of about USD 20 million at present, Yemen exports its coffee from 4000 to 6000 MT/year. However, in the 1950s the export was about 12,000 MT/year. About 100,000 small farmers are involved in coffee production, representing about 9% of all farming households (IFAD 2009).

Table 2.9 Coffee export prices in the selected countries, USD/MT

Year	Jamaica	Yemen	Kenya	Guatemala	Brazil
2003	10,333	**3328**	1426	1198	951
2004	21,140	**4319**	1804	1573	1240
2005	20,975	**4454**	2554	2299	1861
2006	18,841	**4224**	2772	2278	1985
Average	17,822	**4081**	2139	1837	1509

Source: FAOSTAT (2012)

After enjoying the monopoly and great prosperity for three centuries, the Yemeni coffee has gone through trade setbacks and declines due to some unfortunate negative events. Trade started to decrease gradually, and in the nineteenth century, Yemen lost many global coffee markets. The main reason is that coffee production shifted to other regions of the world that competed with Yemen at the time. Some local factors have negatively impacted export and production of coffee in Yemen. A recent study conducted by Al-Zaidi et al. (2016) established the need for launching of agricultural extension and capacity building programs for the coffee growers to narrow knowledge gap and enhance their skills on coffee production. They further advised to use Television and Radio programs for this purpose as the farmers preferred these information media to have the needed information on this strategic crop (Table 2.9).

2.4.1 Why Coffee Production Declined?

There are many factors responsible for decline of coffee production which, besides others, include, irregular water supply, drought to which coffee trees are highly sensitive, insufficient strategic focus, inadequate investment across the value chain, limited research, lack of extension support for the coffee growers, absence of transparent marketing systems, collapse of the standardization system and, lack of branded names. These problems combined have resulted in low productivity and reduced revenues. However, international demand remains high and can absorb significantly increased quantities, provided that quality is improved and consistently maintained.

2.4.2 Qat Production vs. Coffee

Today, coffee plants of the past have been replaced with the semi-narcotic qat trees, remarkably dwindling coffee lands. Estimates for 2012 showed that the planted area of coffee in Yemen declined to 34,900 ha, as opposed to 162,500 ha for planting qat. Coffee production amounted to 19,800 tons, as compared to 190,800 tons of qat (Al-Monitor 2014). As a result, Yemen has been deprived of a significant source of income that could have been as important as other commodities such as wheat and cotton.

Despite all the obstacles surrounding coffee production, coffee is next to oil, and is Yemen's main export. Coffee cultivation is spread throughout most regions of the country. Around one million farmers are engaged in coffee production, although they employ the same primitive ancestral methods to ensure same quality and taste despite the severe water scarcity (Al-Monitor 2014).

Yemeni coffee fetches premium price due to its high-quality, unique flavor and refined taste. In spite of climatic and soil factors which are favorable for production, farmers employ old traditional production practices. Therefore, the country needs to chalk out a comprehensive strategy to facilitate its active participation in the international conferences and exhibitions to learn the best practices in order to augment coffee production at all the stages from production to marketing to compete with other coffee producing countries. It is imperative to adopt the best international practices, which are adopted by other countries associated with the coffee business. For regaining the lost position, it is important to create an agency that could primarily focus on the development of coffee sector. Such an organization will encourage farmers to grow coffee, manage water conservation, facilitate distribution of high quality seedlings of to the farmers, and most importantly employment of competent and qualified technical staff.

2.4.3 Marketing

Marketing of agricultural products in Yemen faces numerous challenges. Small-scale farmers have little access to extension advisory services that could provide vital information to them on marketing their produce. Unfortunately, an effective Market Information System (MIS) does not exist in the country. Due to the limited marketing opportunities provided by traditional retail and wholesale markets, and the lack of associations and organizations, small farmers are at great disadvantage. Besides the fact that the existing markets for agricultural products are inefficient, numerous products do not meet international specifications. The value chain is not well developed for many products, as the processing, packaging, and storage industries are at a low stage of development. Markets operate freely with little government intervention. However, still additional government support is needed in the areas of extension, rules to strengthen farmer cooperatives and associations, setting and enforcing grades and standards to improve quality and provision of credit to support the growth of the processing, packaging and storage industries (IFAD 2013).

2.5 Strategies for Realizing Sustainable Crop Production

The strategies for efficient use of limited water resources to make agriculture profitable, economically efficient, equitable and sustainable include:

Enhancing Crop Production

- Institutional strengthening to promote efficient use of water;
- Conserving water resources to realize sustainable agriculture;
- Increasing farmer incomes through increased water use efficiency;
- Enhancing resource availability, sustainability and quality through water harvesting and watershed management;
- Productivity of agriculture on the rainfed areas can be improved by restoration of the terraces, managing watersheds and water harvesting;
- Productivity of rainfed agriculture can be improved by employing more efficient agricultural water management practices through the adoption of modern irrigation techniques, agronomic packages and water harvesting practices;
- Adoption of crop production packages to cater to the arid environment and resilient in the face of prospective climate change;
- An increased recognition of the role of rural women in meeting food needs, improving nutrition and protecting the environment;
- Improving productivity in irrigated agriculture through modern irrigation techniques and advisory services;
- A strong focus on improving productivity and sustainability of livestock production, as this sub-sector has growth potential and as livestock are the principal asset and economic activity of the poorest and of the landless; and
- Diversification of cropping patterns into new or revived cash crops (coffee, honey, almonds, oil crops etc.) and into more nutritious foods to help improve and diversify household nutrition, and development of related value chains, and parallel reduction of area planted to Qat.

Addressing Environmental Issues, Managing Watersheds and Controlling Erosion

- There is a need to design programs addressing environmental issues with the participation of local communities and mass media. In order to address environmental issues and biodiversity it is important to build extension programs based on the rich indigenous knowledge and the traditional approaches in conservation and utilization of resources which were practiced for centuries and are fading away with the passage of time need to be adopted.
- Surface water should be managed economically and efficiently.
- Efforts be made towards the protection of renewable natural resources from degradation, pollution and depletion and the conservation of biodiversity at the level of the watershed;
- Clear and comprehensive coordination mechanisms are to be established among the stakeholders and the concerned organizations for developing appropriate interventions and constructing suitable structures capable of combating or at least minimizing the erosion hazard and sedimentation into the downstream areas.

Combating Climate Change

- It is not easy to combat climate change. However, some measures like promotion of climate resilient agricultural approaches and technologies could reduce its harmful effects. Some approaches include: implementation of the disaster-risk community action plans; adoption of sustainable agricultural practices to promote the drought/heat tolerant crops; improvement of water management for both drinking water and irrigation through the construction/rehabilitation of resilient water infrastructure and restoration of natural resources and improving the communities by managing natural assets (IFAD 2013).

Empowering Women

- Promote women's skills in coffee growing, beekeeping, tunnel horticulture and micro enterprises;
- Provide technical, financial, managerial training for women;
- Improve domestic water supply;
- Increase entrepreneurial women's access to financial and business services;
- Develop women's agricultural skills, to empower them economically;
- Ensure women's access to savings and credit from MFIs;
- Encourage women representation on management boards of associations.

2.6 The National Extension Service in Yemen

Agricultural Extension Service (AES) is the responsibility of the government and is administered through the Ministry of Agriculture. The role of extension services is usually restricted to the delivery of information to the farmers on the new technologies and government programs. However, its working needs to be improved by creating awareness on sustainable development of the local areas as well. However, the potential role of extension personnel, as vehicles to convey information from rural communities to scientists, planners, and policy-makers, is too often disregarded and most probably inexistent. Therefore, in order to realize sustainable participation of extension personnel in creating awareness, a two-way information flow needs to be ensured (NAP 2000).

MAI reportedly has more than 1300 extension agents and technical experts located throughout the country. Nevertheless, this system is clearly not effective at providing farmers with information and necessary skills to improve their coffee cultivation and marketing. Agricultural extension workers are personnel who are responsible for meeting the goals of extension system. However, there have been less data on the roles and performance of extension workers in the country, even though there are sporadic studies on criticism that extension was not being able to perform the necessary changes in the rural community (Sallam and Akram 2005).

2.6.1 Evolution in the Extension System

Realizing the weakness of Extension systems, several international organizations and donors, especially the World Bank helped strengthening extension services during the 1980s. However, later, the government's priorities changed and extension has been suffering setbacks since 1990s. Until recently, Agricultural Research and Extension Authority (AREA), an autonomous body, remained responsible for both research and extension in Yemen, but the Authority was criticized for focusing on research and ignoring extension. Now, as a result of re-organization, the function of extension has been given to the General Directorate of Extension and Training located within the Ministry of Agriculture and Irrigation. Extension has been decentralized along with other technical departments in Yemen (Qamar 2012).

2.6.2 Agricultural Blocks and Extension Centers

Agricultural Blocks (district level extension offices) and Extension Centers (village level extension offices) have been established in most of the governorates during 1980s when several donor agencies particularly the World Bank focused on strengthening extension services at the request of the government of Yemen. There were four to six Extension Centers under each Agricultural Block. However, as the projects ended and the government's priority for extension gradually declined, the maintenance of the centers lacked due attention and the infrastructure started deteriorating making extension staff and the farmers disappointed. Qamar (2012) noted that out of the total of 467 Agricultural Blocks and Extension Centers, only 392 were functional while some 75 were non-operational due to various reasons including precarious physical condition, lack of operational budget, going away of frustrated resident staff, lack of equipment and transport facilities, and the buildings of the extension offices were encroached by others.

2.6.3 Status of Agricultural Extension

Though agricultural extension has made use of Public media (Radio, TV channels and newspapers) to create awareness on the environment and on the conservation of natural resources for the future generations yet still seems to be in its initial stages, however, slowly gaining acceptance and momentum. Also, programs to address environmental issues with complete participation of local communities and by using different mass media are the need of the day. The school and university curricula need to be revised and updated to accommodate the present challenges of

conserving the fragile environment and sustaining the utilization of limited available resources. Extension activities need to be updated and revived to focus on agricultural and environmental issues in simple and attractive manner, based on the rich indigenous knowledge, traditional approaches and modern scientific practices to realize conservation and utilization of resources. Raising awareness need to be developed and incorporated in the national campaigns and awareness programs at the national, regional and local levels (FAO 2009).

2.6.4 Challenges Faced by Agricultural Extension

Over the last decade, extension service started experiencing some challenges due to socioeconomic changes and agricultural sector reforms taking place in the country. In spite of decentralization in Yemen, only 3.2% of farming households receive any type of extension support. Even in the Internal Plateau Zone, where extension services are most accessible, only 6.6% of households benefit from extension. According to country report on plant genetic resources (FAO 2009), capacity building programs face problems at the individual, institutional and system levels. Reasons behind the unsatisfactory performance of extension are low salaries, weak management, absence of monitoring, evaluation and accountability, negligible budget and transportation facilities, mostly outdated technical information, and technical directorates running independently their own fragmented extension activities. Other issues include:

(a) *Poor linkage between Research and Extension*

Several authors, studies and reports confirm that there are no longer any clear linkages between researchers and extension agents. So, the latter receive few if any refresher courses and on-the-job training (Muharram and Alsharjabi 2001; USAID 2005; NASS 2012).

(b) *Extension workers lack logistic support*

Due to lack of logistical support and with the few vehicles, and nearly no operating funds, extension agents rarely make visits to the farmers, making minimal impacts on the famers and the producers, and have not developed relationships of trust with them (USAID 2005).

(c) *Lack of operational funds*

Extension, like most other technical departments of the Ministry suffers from acute shortage of operational funds. Under the circumstances, donor-funded projects are welcomed as at least temporary source of funds. As indicated earlier, dozens of Agricultural Blocks and Extension Centers, which are located at crucial district and village levels are either non-functional or have been abandoned due to lack of basic residential facilities and their maintenance as there are no funds available.

(d) *Extensionists do not use innovative ways*

Extensionists often adopt academic style for dissemination that fails to make any impact on the farming communities in part because it is dependent on paternalistic lectures rather than visual aids and demonstrations.

(e) *Decentralization has caused negative impact*

Like in many developing countries (Indonesia, Philippines, Tanzania, Uganda, Pakistan, etc.) where decentralization has weakened extension services due to political interference of elected local government officials, Yemen's extension services have also suffered. Proper utilization of budget allocated for extension purposes has become an issue to divert these funds to non-extension activities.

Box 2.2: Problems and Challenges Faced by the Agricultural Extension in the Yemen
Institutional and Organizational Defects:

- Extension department is located at the Ministry of Agriculture and Irrigation (MAI) and the Ministry has massive mandate in agriculture and irrigation;
- Low operational budget allocated for agricultural extension activities accompanied with the absence of transparency leads to misuse of limited budget.
- Limited government financial resources are unable to sustain the inherited inappropriate organizational set up;
- Extension organizations do not make clear job descriptions available to the extension staff and professionals and provide insufficient information on activities to be performed;
- Lack of adequate institutional and technical support for public extension services.
- Inappropriate selection and use of extension methodologies and approaches;
- Prevailing of weak management and supervision at national and regional levels;
- Lacks legislation that could organize various agricultural extension professionals engaged in practicing and services delivery.
- Supervision, monitoring, evaluation and accountability of the extension staff are absent at national level;
- Distribution of available extension and resources at local, national, regional and in different regions, areas, and agri-ecological zones throughout the country are poor and imbalanced.
- Weak coordination among extension services at regional and national levels as well as between extension and other relevant agencies;

(continued)

Box 2.2 (continued)

- Extension services employs on traditional extension approaches. Most recent extension approaches such as participatory extension, rural advisory extension, farming system extension, farmer-to-farmer extension or extension through paraprofessional local agents have not been put into practice;
- Though proved very viable, vibrant and sustainable, yet the republic does not make an extensive use of participatory extension systems.

Extension Staff

- Extension staff are not educated enough to undertake extension activities;
- Low human resources capacity;
- Low salary scale and incentives for agricultural extension personnel;
- Rewards, punishment system and accountability features are absent in the extension service;
- Limited number of female staff in the extension service including public, cooperative and private agencies;
- Absence of suitable plans for the professional development for agricultural extension to make them aware of new policies and newly emerging changes;
- Machines and equipment especially transport vehicles are not available to enable extension staff to perform their duties;
- Low organizational status/position is attached to extension staff as compared to other professionals of other disciplines;
- Extension employees, both technically and managerially are unable to meet the needs of a renewed mandate in agriculture.
- Extension staff prefers to work and/or live in Agricultural Extension Centers (ECs) and Blocks (ABs) as they believe that they would be deprived of basic services away from populated areas as some ECs and ABs are not furnished;
- Extension professionals are assigned multiple job assignments that adversely affect their working in extension;
- Lack of monitoring and evaluation system of the ongoing research-extension farmers
- (R-E-F) coordination linkage mechanism;
- Participation of female and extension agents in specialists research-extension farmers
- (R-E-F) coordination linkage is very low.

Dissemination of Technologies to Extension

- Extension staff are not well equipped with the skills and knowledge on disciplines like: rain-fed farming, livestock, improved management of natural resources, gender and rural women, agricultural cooperatives, post-harvest technologies and marketing of agricultural commodities and socio-economic aspects – market analysis;

(continued)

Box 2.2 (continued)

- Adequate and suitable package of farming technologies and recommendations for various farming systems and ecological zones covered by extension especially for the rain-fed areas are not available;
- Extensionists rely and use mostly outdated technical information;
- Extension service neither gets benefit of current extension techniques, nor any updated technical knowledge regarding current agronomic, business, or management techniques.

Financial and Material Resources:

- Low salaries, weak management;
- Lack of government funding and negligible budget – with only 1.0% of the budget, MAI is expected to serve 54% of the workforce engaged in agriculture;
- Lack of transportation facilities,
- Technical directorates running independently their own fragmented extension activities;
- Public extension system does not function well due to lack of resources (Source: Muharram and Alsharjabi 2001; NASS 2012)

(f) *Training Options for Extension Professionals*

Pre-service education in agricultural extension is offered at agricultural faculties of major universities, i.e. Sana'a University, Aden University and Dhamar University. However, it is equally important that extension agents and officers are exposed to "In-service trainings" on a regular basis. In order to improve the working of extension agents, it is important to equip them with the basic scientific extension methods, and upgrade their scientific and technical abilities to work with research scientists and the farmers through refresher courses and updated on-the-job training to cater to issues of the day (USAID 2005).

(g) *Lack of electricity facilities in the villages*

Not all the villages have been electrified so far. In such cases, Radios instead of television are being used by the farmers. To solve the problem of power supply, extensionists make use of generators to compensate frequent power outages. Cell phones are quite common in rural areas so these should be used.

(h) *Information and Communication Technology (ICT)*

Extension offices, especially those in the governorates and districts, do no employ the modern tools of information technology to supplement their field extension activities. However, a well trained and experienced staff at the Directorate of Information of the General Directorate of Extension and Training do have necessary equipment and studio for preparing television and radio programs besides a large

variety of audio-visual equipment, consequently are using radio and television programs to carry out extension functions and deliver extension messages on a regular basis for the farming communities. Certain equipment though is now obsolete and needs replacement with modern ones.

(i) *Relationship between Agricultural development and Extension Education*

The most viable option to increase productivity in the agriculture sector would be to revisit the government's extension and research capacity. Analysis of current service provision has found it lacking to non-existent in most parts of Yemen. In addition, research and extension do not work together as they should, where advances in research are to be passed on to the farmer through the extension system. Public extension service needs restructuring, capacity building, introducing effective extension techniques, strengthening linkages to research, and recruiting a new male and female extension agents having a positive, service oriented attitude to replace the existing, non-productive and extension agents with low performance. It is important to equip the new recruited employees through capacity building of is needed with updated skills on financial management, efficient water usage, water saving agronomic techniques, introduction of new crops and varieties, and association or cooperative development. These measures taken to improve extension services would have positive impact on agricultural production.

2.7 Strategies for Improving the Working of Agricultural Extension

First of all, it is important to identify the problems faced by the farmers and the Extension Service. Restructuring of extension system would help overcoming the problem of organizational differences, addressing discrepancies, modifying the present institutional position and form of extension in various agencies.

2.7.1 Improving the Working of the Extension Organization

- Identification of extension organizational constraints in different agencies and areas by using the diagnosis tools of Participatory Rapid Appraisal (PRA) would improve its working. Such tools help define the problems, set priorities, and devise possible viable solutions with the assistance and involvement of all concerned parties.
- Organization defects can also be removed by conducting a comprehensive evaluation study on the presence of extension staff in different areas representing various extension agencies; and extension approaches adopted by them to assist the farmers under different farming systems. Such measures could help in the redistribution of extension staff, resources and facilities. It will also help in improving extension approaches and methodologies; formulating human resources devel-

opment plan; staff rationalization, and possibly in developing recruitment guidelines for extension especially female staff.

2.7.2 Elevating the Existing Generally Weak and Transforming Low Organizational Status

- Elevating the existing weak system and transforming low organizational status of extension into a more realistic position that matches with and reflects its importance;
- Supporting extension research and studies aiming at: testing and evaluating extension approaches and methodologies applied in the field; and revising and formulating local versions of tested approaches and methods to develop the package of technology that could be replicated under farmer's field conditions.
- Further follow on studies must be conducted to investigate the adoption and impacts of commercialization of advocated farming technologies.
- Attitude of the researchers, extension staff, and farmers towards new extension approaches and methods deserve continuous and perpetual evaluation to check distortions and make improvements.
- There is a need also to foster and institutionalize relationships concerning extension with various relevant agencies under which extension is operating considering legal, organizational and financial dimensions affecting such relationships, including gender issues and rural women development.
- Extension departments be given more authorities and control over the allocated budget.

2.7.3 Redefining the Extension Role and Responsibilities

Such an initiative would also necessitate redefining extension roles and responsibilities at national and regional levels. A readjustment must consider various internal and external changes and resultant new trends and policy guidelines especially program budgeting, the needs for rules and regulations including job description and criteria for occupying extension posts at all levels and working circles.

2.7.4 Improving the Working Living Conditions of the Extension Workers

- Agriculture extension is viewed as a fundamental pillar in agricultural and rural development, food security, improving living standards; farmer and rural economics and shielding the future challenges like free market system including the agreements of the World Trade Organization (WTO).

- Based on its constructive roles, it seems imperative to activate and revitalize the role of agricultural extension and its national institutions on a country level. Its rehabilitation, strengthening and developing its capabilities in various aspects would enable it to function efficiently and effectively meeting the future challenges and resulting agricultural development.

2.7.5 Strengthening the Linkages Between Research and Extension

At present, extension activities are carried out under numerous agencies. The reorientation of all these agencies seems imperative. It is important to involve all levels of management and staff with the aim of enabling them comprehend and deal with the new government policies and directions. Further, revisiting, restructuring and renovation of the existing Extension System would help overcome the organizational differences and discrepancies affecting the present institutional position and form of extension in various agencies (Muharram and Alsharjabi 2001; NASS 2012). Another viable option would be, though presents a tremendous challenge, but also a tremendous opportunity, to start over creating a new extension service that could be public, private, or a combination of the two. Though the country needs complete overhauling yet based on the identified constraints and the obstacles, its working can be improved by:

- Updating extension activities in agriculture and rural areas;
- Allocating adequate annual operational budget and making sufficient funds available by employing easy procedures for the efficient functioning of agricultural extension and carrying out extension activities;
- Improving the salary scale and incentives of extension personnel.

2.7.6 Strengthen the Links and Establish Coordination Among Agricultural Organizations

All the organizations working in research, development sector and extension outreach programs need to establish working relationships and beneficial coordination with each other to make the information flow efficient among them and finally to the farmers. Establishing suitable coordination linkage mechanisms among extension services and the cooperative and the private sectors, with flexible and varied options would help achieving the aims and interests of various agricultural and rural development partner organizations.

Establishment and strengthening of partnerships among the farmers, private sector, government, and donors is necessary and could be realized through:

- Enhancing cooperation and coordination between agricultural extension and all other government and civil agencies relevant to the context of agricultural and rural development;
- Developing linkage mechanisms and partnerships with the private and cooperative sectors to lessen the stress on the government resources and multiply the extension efforts in order to achieve the aims and interests of various participating agricultural and rural development organizations;
- Developing and activating existing institutional bodies (i.e. extension services, technical committees, coordination units, national extension committee, the multi-disciplinary teams etc.) to make extension effective and efficient;
- There is a need to define the roles and responsibilities of all the stakeholders and partners as outlined in National Extension Strategy.

2.7.7 Moving Towards Innovative Rural Extension

First step in any extension program is to create awareness among the farmers regarding what to deliver and how to deliver so that farmers could help to help themselves. Once farmers get to know extension, then there is a need to revitalize the extension service, which will be the key to improving the productivity of agriculture, and raising rural incomes.

On the basis of identified constraints and obstacles, the following suggestions are proposed to overcome the problems and make agricultural extension effective and efficient by:

- Developing an active and typical information service that caters to the information needs of extension personnel in all fields relating to their work, in a suitable and timely manner by employing the right channels with proper contents systematically and regularly;
- Adopting and employing best proven extension techniques, to transmit an updated technical knowledge regarding current agronomic practices, business, or management techniques.
- Arranging trainings on “How to do Agri Business and making more profits by smart marketing of agricultural products. Currently Extension service does not provide trainings to the farmers as well the extensionists although it is also the part of the extension service.
- At this point, cash infusions, and a few training courses for underpaid and unmotivated extension staff, will not contribute towards the development of the agriculture sector.
- Develop and launch awareness and extension education and capacity building programs involving all the concerned parties.

2.7.8 Making Use of Communication Media

Numerous means of public media (Radio, TV channels and Official newspapers) are available in Yemen to create awareness on the importance of the environment and the need to conserve our natural resources for future generation. However, such endeavors are in their initial stages, and are gaining momentum slowly.

2.7.9 Adopt Participatory Approach

While working for the development of agriculture, NASS consultations made field visits to meet the stakeholders. The stakeholders emphasized the successful working of participatory approaches during the past decade. All of them believed that a highly participatory approach involving communities is the most effective way to ensure sustainability and improvements in production and food security.

Stakeholders emphasized that by participation they mean involving the selected communities in the full cycle of activities starting with the decision-making process for investments and services, followed by supervision, management and physical implementation of the activities, monitoring physical and financial aspects.

While working in the field, NASS consultants were informed by the stakeholders about the proposed key elements essential for the participation. The mechanisms include: setting up of community and producer associations at the local level; cooperatives need to strengthen partnership at the community level and empowerment of farmers in marketing and purchases; community mobilizers to act as the interface between communities and community planning and the services responding to community demand; community-based extension and animal health workers; and ensuring joint and participatory Monitoring and Evaluation (Government of Yemen 2013).

Community involvement in planning and implementing development projects from the outset is essential for their success, future ownership and sustainability. Appropriate guidance during participatory planning process by trained facilitators is a key factor of success of project activities.

Enthusiasm for community-driven approaches to development has been successfully demonstrated in the ongoing programs. Appropriation by well-trained communities of their Community Action Plans, infrastructure and productive investments is a guarantee for long-term sustainability.

Based on the past experiences as reported by the Government of Yemen (2013), encouraging and promoting the direct involvement of the beneficiaries in planning, implementation and of the projects in all the steps and activities would result in positive outcomes.

2.7.10 Importance of the Indigenous Knowledge

The combination of indigenous knowledge and modern approaches works better than trying them in isolation. Indigenous knowledge is based on the life-long experience of locals whereas modern technical practices are based on tested scientific principles.

Indigenous knowledge regarding conserving and managing natural resources, practicing traditional agriculture and managing grazing lands can add value to the modern scientific technical know-how. While developing such practices, it is important to attach due consideration to the Indigenous knowledge while addressing technical environmental issues.

2.7.11 Up-Date Curricula

FAO (2009) stressed the need for revising the curricula at the school and university levels and update it to accommodate the challenges of conserving the fragile environment and sustaining the utilization of limited natural resources available.

2.7.12 Reliable Monitoring and Evaluation System

- Developing a reliable monitoring and evaluation system with reasonable appreciation and incentives of promotion for extension staff is important. A comprehensive evaluation of extension in different extension agencies, and the approaches applied under different farming systems needs to be conducted. Such initiatives will help the fair redistribution of extension staff, resources and facilities to meet the priorities and satisfy the new goals set by the extension.
- Ensuring the active participation of government, private and cooperative sectors and all other key stakeholders in implementing, monitoring and/or evaluating the plans and making recommendations for realizing sustainable agricultural development.

2.7.13 Logistic Support

Required and needed support like machines, equipment and furniture for extension work in selected areas must be provided. Also, developing an active and efficient information service that caters to the information needs of extension personnel in all fields relating to their work, in a suitable and timely manner through the right channels with proper contents systematically and regularly will help.

2.7.14 In-Service Trainings

Well-planned and focused meetings and orientation training-cum-workshops for the extension staff would educate them on the new government policies with regards to extension and the role of extension. In-service trainings for reorientation of all extension staff to enable them to grasp and deal with the new government policies and directions must also be conducted.

2.7.15 Extension Needs to Make Farmers Market-Oriented

If the farmers make more profits based on the information and guidance provided by extension, they will have an enhanced trust in extension. However, small scale farmers do have little access to extension advice on markets for their products, and on the other hand, an effective Market Information System (MIS) does not exist in Yemen to benefit and assist the subsistence farmers.

2.8 Conclusions and Recommendations

In Yemen, many factors are responsible for negatively impacting agriculture which includes: increased land degradation and soil erosion, changes in water availability, biodiversity loss, more frequent and more intense pest and disease outbreaks as well as un-expected natural disasters. In addition to agricultural issues, Yemen also suffers from political unrest and faces many other socio-economic challenges like high levels of poverty, rapidly increasing population, severe resource constraints, and food security concerns. However, by devising various strategies, agriculture sector can be improved and to some extent, it is capable of addressing the challenges faced by the country.

- The discussion made in the chapter leads to establish that sustainable agricultural development can enhance domestic agricultural production, alleviate poverty in rural communities, preserve environment and conserve dwindling natural resources if supported and backed by the appropriate policies.
- In order to combat poverty, it is important to focus on developing the value chain for: (i) high-value commodities (e.g. coffee, honey, horticultural products) by involving the private sector; and (ii) fisheries. Both the sectors carry the significant potential to reduce poverty reduction and enhance economic growth. High-value crops could be suitable alternatives for the small farmers presently growing qat.
- In order to make agriculture sector sustainable, the crops should be grown based on the availability of resources and their suitability to their corresponding environment. Efficient and sustainable use of scarce natural resources like water and land can elevate and improve crop yields and make agriculture sector sustainable

and economically viable. Sustainable agriculture can be realized by using the agricultural inputs such as seeds, fertilizers, agricultural mechanization, irrigation systems judiciously and efficiently; making the modern scientific knowledge on agricultural techniques, management of crop and yield, and animal health improvement available to the farming communities through organized agricultural extension; creating marketing opportunities and appropriate environment that could provide means and tools for large and small farmers (NASS 2012).

- Livelihoods of rural communities can be elevated by providing them with improved inputs and developing their knowledge. It is argued that food requirements of increasing population cannot be fully met by developing agriculture sector, as arable land resources are limited and insufficient to expand agriculture base. Certain NGOs and individual experts are involved in extension activities like training of farmers, funding of small projects in livestock, agriculture terraces, pastures management, bee-keeping, etc. Their participation should be encouraged.
- The country is in dire need of multi-sectoral initiatives to address the issues like food security, climate change, and poverty reduction. However, the development of agriculture sector from technical, economic, and policy perspectives, can be easily integrated into multi-sectoral strategies.
- Implementation of the National Water Sector Strategy with true letter and spirit would boost agriculture due to continued accessibility of water.
- The development of coffee production and its marketing on scientific lines would enhance exports and generate revenue in the country that can boost the national economy to some extent. More efforts should be focused to bring behavioral change in the rural communities to grow food commodities instead of growing qat. It is recommended that qat production must be replaced with the coffee crop to earn foreign exchange.
- Agricultural Extension Service serves through the Ministry of Agriculture and is responsible to deliver information on new technologies and government programs to the farmers. However, its working needs to be improved by creating awareness to realize sustainable development. Extension workers are the key players in creating awareness, however, they are unable to do their jobs due to the lack of basic facilities like furniture, logistic support vehicles and operating funds. In addition, they are entrusted with non-extension and multiple tasks not falling under the mandate of the Extension service. Therefore, it is important to give them a clear line of action and their performance must be evaluated through a reliable monitoring and evaluation system. Extension staff deserves reasonable appreciation and incentives of promotion based on their performance. Participatory approaches in Yemen involving communities have proved the most effective way to ensure sustainability, improvements in production and food security. Therefore, it should remain the working extension strategy to realize sustainable agriculture development in the country.

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References

ACSAD. (2002). Land degradation in republic of Yemen: Summary report of land degradation project in republic of Yemen. The Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD). Ministry of Agriculture and Irrigation, Sanaa (Yemen). Ministry of Tourism and Environment, Sanaa (Yemen). Available at: http://www.acsad.org

Al-Kharasani, M. A. A. (2014). Climate change and agriculture in Yemen. *African-Asian Journal of Rural Development, 47*(2), 61–80.

Al-Monitor. (2014). *Yemen's coffee revival. Al-Monitor: The pulse of the Middle East*. Available at: http://www.al-monitor.com/pulse/culture/2014/02/yemen-revive-historic-coffee-trade.html. Assessed on 2 Apr 2015.

Al-Shehri, S. (2011). *Yemeni coffee crop: Historic fame, production areas and the famous types*. Available at: https://ar-ar.facebook.com/notes/feecoffee//297430906966087. Accessed on 25 Dec 2014.

Al-Zaidi, A. A., Baig, M. B., Shalaby, M. Y., & Hazber, A. W. (2016). Level of knowledge and its application by coffee farmers in the Udeen Area, Governorate of Ibb – Republic of Yemen. *The Journal of Animal & Plant Sciences, 26*(6), 1797–1804.

Almasa, A. A. M., & Scholzb, M. (2006). Agriculture and water resources crisis in Yemen: Need for sustainable agriculture. *Journal of Sustainable Agriculture, 28*(3), 55–75. https://doi.org/10.1300/J064v28n03_06.

CFSS. (2012). The state of food security and nutrition in Yemen. Comprehensive Food Security Survey (CFSS). World Food Program (WFP). Report Available at: https://www.humanitarianresponse.info/sites/www.humanitarianresponse.info/files/assessments/CFSS%2C%20YEMEN%2C%202012.pdf

FAO. (2009). Country second report on the state of world's plant genetic resources for Food and Agriculture in Yemen (1996–2006) (pp. 1–48).

FAOSTAT. (2015, 2016). Country profile–Yemen. Food and agriculture organization of the United Nations. Available at: http://www.fao.org/faostat/en/#country/249

FAO. (2015). Millions of Yemenis face food insecurity amidst escalating conflict. Food and Agriculture Organization of the United Nations. Available at: http://www.fao.org/news/story/en/item/283319/icode/

FAO. (2016). *FAO warns of rapidly deteriorating food security in Yemen*. Available at: http://www.fao.org/news/story/en/item/380653/icode/

GAFSP. (2013). Proposal for Yemen: Smallholder agricultural productivity enhancement program. Phase-1 Roll out of National Agriculture Sector Strategy (NASS) for Yemen's Efforts towards achieving food security under Global Agriculture and Food Security Program (GAFSP) Sana'a. June 4th, 2013.

GFSI. (2016). *Global food security index. An annual measure of the state of global food security* (p. 9). Washington, DC: The Economist Intelligence Unit Limited 2016.

GIEWS. (2015). *Country brief – Yemen*. Available at: http://www.fao.org/giews/countrybrief/index.jsp

Government of Yemen. (2013). Proposal for Yemen: Smallholder agricultural productivity enhancement program phase one roll out of national agriculture sector strategy (NASS) for Yemen's efforts towards achieving food security under global agriculture and food security program (GAFSP) Sana'a June 4th, 2013.

Hugh, T., Burke, J., & Faurès, J. M. (2011). *Climate change, water and food security*. Rome: Food and Agriculture Organization of the United Nations 2011, 174 pp., Softcover, isbn:978-92-5-106795-6.

ICARDA. (2012). *Combating land degradation in Yemen – A national report*. A review of available knowledge on land degradation in Yemen – combating desertification in Yemen – Oasis Country Report 4 (pp. 1–81). Available at: www.icarda.org

IFAD. (2007, December 11–13). *Country strategic opportunities paper (COSOP) 2008–2013*. Document EB 2007/92/R.18. Rome.

IFAD. (2009). Enabling poor rural people to overcome poverty in Yemen. International Fund for Agricultural Development, Rome. Available at: https://maintenance.ifad.org/documents/38714170/39150184/Enabling+poor+rural+to+overcome+poverty+in+Yemen.pdf/0b2360c9-68b6-4fb7-bf3b-8c702fd65569

IFAD. (2013). Rural growth programme (pp. 1–189). Detailed design report Main report and appendices. Document Date: 20 Aug 2013. Project No. 1672 Near East, North Africa and Europe Division Programme Management Department.

IFAD (International Fund for Agricultural Development). (2013). Harvesting water to increase productivity. Seeds of innovation: NENA and CEN Regions. Rome. www.ifad.org/operations/projects/regions/pn/infosheet/IS4_Sudan.pdf.

IFAD. (2015). A gender balanced model for community development model. Seeds of Innovation. Near East North Africa and Europe Office of IFAD (International Fund for Agricultural Development). Fact Sheet. Available at: https://www.ifad.org/documents/38714170/39150184/gender+balanced+eng.pdf/ec76284c-adf3-417b-8d6dc695d0b48316

IFPRI. (2011). Yemen national food security strategy. Overview and Action Plan. International Food Policy Research Institute, Washington, DC 20006–1002 USA. Ministry of Planning & International CooperationFood Security Strategy Program, Sana'a - Republic of Yemen. Available at: http://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/124805/filename/124806.pdf

IRIN. (2007). *Yemen: Land degradation threatening farmers, says senior official*. News published on Oct 18, 2007 in IRIN International News. Available at: http://www.irinnews.org/report/74843/yemen-land-degradation-threatening-farmers-says-senior-official.

IRIN. (2012). *YEMEN: Time running out for solution to water crisis*. An article published on August 13, 2012. Available at: http://www.irinnews.org/report/96093/yemen-time-running-out-for-solution-to-water-crisis

Muharram, I. A., & Khalil, M. A. (2001). The situations of Agricultural Extension in Yemen: A quick Overview. The Yemeni Journal of Agricultural Research and Studies, Issue no. 5, Agricultural Research and Extension Authority (AREA), Dhamar -The Republic of Yemen.

NAP. (2000). National Action Plan. Published by the Government of Republic of Yemen, Sana. The Republic of Yemen.

NASS. (2012). A promising sector for diversified economy in Yemen: Strategy jointly prepared in cooperation with the United Nations Development Program, Economic Diversification Support Program (Agriculture Sector) and the Ministry of Agriculture and Irrigation. Ministry of Agriculture and Irrigation. National Agriculture Strategy – 2012–2016. The Republic of Yemen.

New Agriculturist. (2010). *Country profile – Yemen*. Available at: http://www.new-ag.info/en/country/profile.php?a=1371. Assessed on 5 Apr 2015.

Qamar, M. K. (2012). Extension in Yemen.Global Forum for Rural Advisory Services. Available at: http://www.g-fras.org/en/world-wide-extension-study/130-world-wide-extension-study/asia/western-asia/330-yemen.html#history.

Sallam, M., & Akram, B. (2005) *Agriculture extension situation in Dhamar province*. Dhamar Rural Development Project, Ministry of Agriculture and Irrigation, Yemen.

UNDP. (2015). *Yemen conflict paralyzes economic activity, puts women businesses at risk*. http://www.undp.org/content/undp/en/home/presscenter/pressreleases/2015/11/16/yemen-conflict-paralyzes-economic-activity-puts-women-businesses-at-risk.html

USAID. (2005). *Moving Yemen coffee forward assessment of the coffee industry in Yemen to sustainably improve incomes and expand trade*. Publication produced for review by the United States Agency for International Development. Prepared by ARD, Inc.

USAID. (2016). *YEMEN country development cooperation strategy 2014 – 2016*. Available at: https://www.usaid.gov/results-and-data/planning/country-strategies-cdcs

World Bank. (2002). *The Republic of Yemen – economic growth: sources, constraints and potentials*. Washington, DC: The World Bank.

World Bank. (2006). *Country assistance evaluation. independent evaluation group*. Washington, DC: World Bank.
World Bank. (2009). Yemen: reducing serious water stress. Water in Middle East and North Africa. http://go.worldbank.org/SOS3F9MVY0
World Bank, FAO (Food and Agriculture Organization of the United Nations), and IFAD (International Fund for Agricultural Development). (2009). *Improving food security in Arab Countries*. Washington, DC: World Bank.
World Bank. (2011a). World Development Report 2011: Conflict, Security, and Development. Washington, DC.
World Bank. (2011b). World development indicators database. Accessed 10 Sept 2014. http://databank.worldbank.org/.
World Bank; United Nations; European Union; Islamic Development Bank; and Yemen, Ministry of Planning and International Cooperation. (2012). *Joint social and economic assessment for the republic of Yemen*. Washington, DC: World Bank.

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