A SOCIO-ECONOMIC ANALYSIS OF LAND SETTLEMENT IN LIBYA: THE CASE OF WADI AL HAI PROJECT

ABDULKARIM MOHAMED .K. AMARA

A thesis submitted in partial fulfillment
of the requirements of the
University of Northumbria at Newcastle
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ABSTRACT

The present study is concerned with the settlement and agricultural development process as it is taking place in the Wadi Al-Hai agricultural project and the influence of some socio-economic factors on the agricultural exploited area.

The Wadi Al-Hai project is one of the most important agricultural development projects in Libya. It is located 85 km south-west of the capital city Tripoli, and includes 417 farms, with each farm being 25 hectares, and consisting of a modern house and all agricultural requirements.

For the empirical study, two types of analysis will be used:

- Descriptive statistical analysis: describing the study the main features of the structure of agriculture development in the Wadi Al-Hai area, and the economic situation of the farmers in the project. The data for this part were analyzed on the basis of simple but appropriate statistical measures, such as frequency ratios, means and distributions, standard error and the chi-square test.

- Econometric Analysis: using economic statistical analysis and the relations between different economic and social variables in a set of mathematical models aiming to explore the potential contributions and influences of such factors in this project. In short, a log-linear cross sectional model is developed aiming at relating the relevant socio-economic factors to the exploited areas.

Also the study is based on a survey of 105 settlement households located in the Wadi Al- Hai project. Key socio-economic characteristics of the farmers are related to their experience and quantitative survey data are supplemented by qualitative interview material. Additional documents were provided by the Council of Agricultural Development, Secretariat of Planning.

The theoretical analysis is based on economic development and growth with reference to agriculture and agricultural development in Libya.

A number of weaknesses in the project are identified such as in the operation of co-operatives, marketing arrangements, extension services and water management.

In conclusion, some agricultural policy recommendations are made for the exploitation of natural resources and human resources in the project.

Our initial results indicate that all the variables studied have statistically significant effects on the agricultural exploited area in the project.

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CN	Condition Number.
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CHAPTER ONE

INTRODUCTION & PURPOSE OF THE STUDY

1.1. Introduction

For the importance of establishing and consolidating sustainable development and raising living standards, the Al-Fateh Revolution has paid considerable attention to agriculture sector. It launched the so-called agricultural revolution, which implicitly means a transformation of the traditional agricultural techniques into new and advanced agricultural modes. Therefore, the economic development, in general and agricultural development in particular, have become a pivotal cornerstone of every development plan in Libya.

Accordingly, economic development in Libya has acquired a new perspective based on the crucial contribution of agriculture to the national economy, by increasing production through comprehensive structural adjustments in the productive modes and techniques in all economic sectors.

Since its discovery in the 1960s, oil has emerged as the major source of the state's revenues, and it has supported the state's capabilities by creating budget surpluses that have enhanced economic development. Oil has become the sole catalyst for the different economic sectors, and for agriculture in particular. On the other hand, the emphasis on oil and oil-related activities has led to a serious undermining of agriculture and industry, bringing a significant case of the" Dutch Disease". This led to serious sectoral migration of human resources and the skilled workforce into the oil sectors. It has also caused an expansion in the administrative and service sectors deviating from the normal development path in

terms of resources and the population. Moreover, increases in income per capita have enabled individuals to increase their demand for goods and services without a parallel increase in the national supply, which has led imports to surge significantly. With jobs and services being concentrated mainly in the urban areas, rural-urban migration has led to a series of social and economic bottlenecks.

In tackling the above-mentioned economic structural imbalances, the Libyan government promulgated a constitutional declaration on 5 December 1969, which set out a three-year development plan for 1973-1975 and the two five-year plans for 1976-1980 and 1981-1985 respectively. These plans adopted a general framework for promoting agriculture aiming to achieve the following:

- Acquiring autarky in cereals, vegetables, fruits and meat in the shortest possible time.
- Ending the fragmentation of land ownership by aggregating units into integrated farms, enabling the use of modern mass production techniques.
- Enhance peasants welfare.

As a major part of such transformations, five development projects were introduced as follows:

1. Agricultural settlements in the Jafara plain: including projects in the Al-Khair valley, Haira valley project, Hai valley, Tirfas well , Sidi al-Said, Gharian pastures and Keaam valley.

2. Agricultural settlements in Benghazi: comprising the Al-Jabal Al-Akhdar project, forests and grazing, Ben-Ghazi plain, Al-Bab valley, Al-Gatara valley, Gaut Al-Sultan, Al-Fateh plain, Al-Wasta, Margooba and Um al-Rruzem.

3. Agricultural settlements in the middle region: including the Zamzam valley, Abu Nujaim, Sof Al-Jeen valley, the Alby great valley, Jarif valley. Tilal valley, Sirt pastures, Maymoun pastures, Al-shuwairif, Al-Furjan, Al-hamam and Zallah.

4. Agricultural settlement in Al-Kuffrah: including the Al-Kuffrah project, Jalo and Ojeela project and Mradah project.

5. Agricultural settlement in Sabha: including the Sabha project, Al-shati, Khan al Owinat, Mourzeg and Al-Gatroon.

These projects aimed at both increasing the amount of cultivable land and establishing a permanent basis of self-sufficiency and food production. The specific objectives of the settlements were: firstly to increase agricultural production; secondly to improve standards of living, particularly in the case of low income families; thirdly to reverse the trend of rural-urban migration, and fourthly to abolish or reduce the prevailing system of the tribal ownership of land.

The settlement projects included four types of farms, these being irrigated farms, dry farms, mixed irrigated and dry farms, and grazing farms. These farms were supplied with the most advanced means, housing and the social and cultural services and facilities that would allow their transition from a traditional way of life to modern conditions of agriculture and personal life styles.

The Wadi Al-Hai project, however, is one of the most important agricultural settlement projects in Libya, as the executive authorities have been drawn out for this project in order to closely administer the agricultural development in this region. In addition, this project aims to settle nomads in the region and provide jobs for them in order to raise their living standards through maximizing their income generated from selling agricultural products.

The public sector provides farmers with most of the facilities needed for agricultural development. The government has the financial resources and the intention to improve agricultural settlement projects by increasing the agricultural exploited area, but the areas that may potentially handicap the authorities are strongly related to some socio-economic factors.

The present study is concerned with the settlement and agricultural development process as it is taking place in the Wadi Al-Hai agricultural project and the influence of some socio-economic factors on the agricultural exploited area. It is therefore anticipated that the land exploited is a major indicator of the success of the project – the more land allocated to development, the larger would be output and incomes. In short, the success of the project rests on promoting a higher use of land for agricultural/farming purposes.

1.2. Importance of the study:

1- The main goal of this agricultural development has been to achieve self-sufficiency in food, raising the productivity of the workforce, capital and land, and to improve the farmers' living standards. Being a socio-economic project, one should be able to identify factors giving rise to the success/failure of this project, hence leading us to explore the possibility of applying a cost-benefit approach to the project.

2- To date, very little applied economic analysis has been conducted in assessing the real influence of relevant social, political and economic factors on these agricultural exploited areas. In particular, no independent survey has been applied evaluating the effectiveness of the settlement project in Wadi Al-Hai.

3- To provide policy-makers with information relating to the extent of the contributions made by these factors to the success of the project, hence enabling them to direct resources more effectively.

1.3. Aims of the Study:

The study, therefore, aims to achieve the following:

1- To identify and critically examine economic and topological factors, such as soil, irrigation water, fertilizers, giving rise to the success / failure of the Wadi Al-Hai project, and their influence on the agricultural exploited area;

2- To identify and critically examine social / non-quantified elements such as the farmer's education, age, experience, devotion and willingness, for their

responsibility for the success / failure of the Wadi Al-Hai project, and also their influence on the agricultural exploited area in the farms in this project.

3- To derive some relevant policy implication based on the results and direction of our findings, for maximising the welfare of the farmer in the project.

1.4. The case study:

The Al Wadi Al-Hai project is one of the most important agricultural development projects in Libya, and is located 85-km southwest of the capital city Tripoli. This project aims to:

1- Reform about 10425 hectares of land: 4000 hectares in the first stage divided into 160 farms and 6425 hectares in the second stage divided into 257 farms:

2-Achieve self-sufficiency in cereals, vegetable, fruit and meat in the short term.

3-Improve the farmers' incomes and standards of living.

The project has been implemented in two stages as follows

-The first stage started in 1972 and includes 160 farms, with each farm covering 25 hectares, and consisting of a modern house and all agricultural requirements.

-The second stage: started in 1975, and includes an additional 257 farms, with the same design and specifications set out in stage 1.

1.5. Methodological Issues:

1.5.1. Data

This study employs a combination of both qualitative and quantitative methods in evaluating the social and economic issues arising from the implementation of the agricultural project in Wadi Al-Hai. In so doing, a large quantity of data and other information have been collected from the following sources:

1- Secondary data: documentary surveys, government documents, records, reports, published statistics, bulletins, periodicals, journals, theses and other relevant material.

2- Primary data: by the means of a questionnaire distributed to, and collected from, the selected farms. The preparation and administration of the questionnaire passed through five stages and these are summarized as follows:

a- Exploratory visits to the farms between April and May 2003, meeting with the farmers, and making general enquiries about the project through officials, management teams and farming representatives.

b- Some modifications were made to the questionnaire, following the visit to the farms, to allow for the applicability and efficiency of conducting the survey.

c- A pilot study was conducted initially, following the final modifications to the questionnaire. In this process 20 farmers agreed to complete the questionnaire and to report back any unclear questions or general/specific weaknesses. The pilot study proved to be extremely positive and helpful, as a further, though small, number of modifications had to be made. This stage was completed by June 2003.

d- The final version of the questionnaire was distributed between July and August 2003 amongst all the 105-farming households (of both stages) of the Wadi-Al-Hai project. All the completed questionnaires were returned by late August 2003.

e- Interviews. Having examined the completed questionnaires thoroughly, the author decided to conduct interviews with some selected farmers, as a small number of discrepancies had emerged. In that process, 25% of all participant farmers were visited and interviewed. Although this process took about three weeks to complete, it proved to be of great value, as the farmers felt happier to disclose more detailed information about their activities and financial issues. Moreover, a small but rather fruitful number of interviews were made with the policy-makers and general managers of the project. In this way the author was able to compare and contrast the views expressed by the two groups, primarily about economic resources, social issues and general welfare. All of these interviews were completed and compiled by the end of September 2003.

1.5.2. Empirical Analysis

Two types of empirical data analysis were used:

- **Descriptive Statistical Analysis**: this described the main features of the structure of agriculture development in the Wadi Al-Hai area, and the economic situation of the farmers in the project. The data was analysed on the basis of simple but appropriate statistical measures, such as frequency ratios, frequency tables, and percentages.

- **Econometric Analysis:** using economic statistical analysis and the relations between different economic and social variables in a set of mathematical models aiming to explore the potential contributions and influences of such factors in this project. In short, a log-linear cross sectional model is developed aiming at relating the relevant socio-economic factors to exploited areas. Through this process, the impact of each factor in determining the use of land and the overall impact of all the relevant factors in the success/failure of the project could be estimated.

1.6. Previous studies:

Due to the rarity of previous studies dealing with social and economic factors, affecting cultivated land as well as productivity, especially in Libya, close reference is mad to relevant studies in this area. These studies have been conducted in Libya and some neighbouring Arab countries that are, in a general sense, similar to it. This will help us to recognise the different aspects of the research problem as well as highlighting the most important findings of these studies.

1.6.1. In 1990 Abu Zaid assessed of the current farming activities in the Al-Jabal Al-Akhdar area. The study included some information about the area involved well as the economics of the agricultural resources, the composition of products, and the farm income from plant and animal products as well as the spending of this income by families. Also the study addressed the most important socio-economic

factors that affect the cultivated land in the area. The study drew the following conclusions:

-Most farmers in the area were ageing, with around 47% above 50 years old.

-37% of all farmers were illiterate.

-Most farmers had reasonable experience in farming, with 90.4% of them exceeding 5 years.

-The soil was pre dominantly clay.

-64% of the farms that were surveyed were irrigated mostly by sources other than ground water. Rain farming was estimated at 90.4%.

-Around 92.3% of the farms used normal soft water, whereas only 3.1% of the farms used hard water (with sulphur content).

-93% of the products were farm products, while fruit constituted only 7%. The farm products included barley (60%), wheat (24%) and oats (10%). Moreover, grapes and apples each mad up 3.5% of total fruit products.

The study finished by highlighting some of the problems and difficulties that had been faced, and proposed further studies.

1.6.2. In 1987 Shadi Sharghwi studied the problems of the workforce in agriculture. The study referred to the reformed land in the Arab republic of Egypt. The study emphasised that the main problem was that the Egyptian farmer found it hard to cope with modern irrigation systems. Consequently the efficiency of running such systems was lower. In addition to that, shortages in maintenance

facilities for those systems constituted another problem. The study also identified problems facing agricultural education. Those problems included lack of reform, which resulted in additional costs for the users in reintroducing the required reforms, and also a loss in soil fertility, which greatly affected the cultivated area as well as productivity. The study also stressed the necessity for training the workforce to cope with modern technology. This can be done through intensive training programmes, education, extending technical advice to farmers, and improving soil fertility by adding organic and chemical fertilizers.

1.6.3. In 1994 the Iricard organization conducted a study on arid and semi arid areas. This involved a study of the water resources for the Wadi Al-Hai agricultural scheme. It revealed the following facts:

-The main problem facing the farmers concerned water resources for irrigation, as they failed to irrigate an area of 3-hectare allocated for this purpose. The study also discovered that most of the water wells were either out of use or otherwise inaccessible to the scheme farms. For this reason, however, the farmers in the first stage were allocated only 5 hours irrigation every four days.

-The water for second stage farms was even less, and was not be enough to irrigate 3 hectares. The amount of water allocated for this stage could irrigate some of the trees, which usually do not need much water. However, part of this water was also used to irrigate a very limited area of land to cover the farmers` needs for vegetables and other products, provided the weather conditions were favurable.

Yet, in the case of adverse weather conditions during the summer, this water was of very little use.

Therefore, the above studies involved field survey of the effects of some social and economic factors on the cultivated land as well as on agricultural production. These studies have revealed that some of these factors have great effects on the cultivated land and productivity. Hence, it follows that deficiencies in any of these factors might restrict the area of cultivated land, and will eventually lead to a decrease in production. Consequently this will have negative effects on income as well as the standards of living for farmers.

The present study is divided into **six** chapters. **Chapter One** deals with the general framework and aims, methodology and previous studies in this area. **Chapter Two** examines the theoretical framework and the role of agriculture in economic development, with special reference to developing economies. **ChapterThree** considers the agriculture development strategies in Libya, making references to the role of agriculture in current development strategy, the main characteristics of agrarian development and related problems. In addition, it examines Agrarian Planning, and the Agrarian Development Plans 1973-1985, the importance and growth of the gross domestic product, the problems and difficulties that faced the execution of the agricultural reform, and land use and budget allocations. **Chapter Four** introduces the case study, its location and physical characteristics. **Chapter Five** provides a detailed analysis of the data collected from questionnaire,

interviews and other sources. It covers the production mode and system, marketing features, co-operative and the main agricultural features of the Wadi Al-Hai project. **Chapter Six** presents the model specifications and econometric estimates. Finally, **Chapter Seven** presents a summary and the conclusion of the research, and offers some policy recommendations based on the findings.

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CHAPTER TWO

THE ROLE OF AGRICULTURE IN ECONOMIC DEVELOPMENT

2.1. Introduction

Economic planning involves the methods used in different countries in the world to control and manage the various economic activities. Therefore, economic planning is a tool used by the state in order to achieve its long-term and medium-term goals at the socioeconomic level. However, long-term goals include the achievement of economic and social prosperity for citizens and the development of the national economy to reach the point of full independence. Yet, it is common knowledge that the achievement of such long-term goals is dependent on the medium-term ones, which include the development of agricultural production as well as developing productive power in urban and rural areas. Also they include establishing industrialisation and boosting production at the various economic levels (Berry and Cline, 1979).

The general plan for economic development is usually made up of minor plans at the sectoral level, such as industrial plans, agricultural development plans and plans for developing domestic and foreign trade. The agricultural development plan is used by the state as a means to carry out its economic policies in rural areas, where agricultural planning is crucial. Hence many points must be taken into consideration once planning starts until the final stages of the implementation of the agricultural development plan. However, the planners and executors must create the right environment for the fulfillment of the aims of the plan. These aims should include the wise use of the available resources in rural areas, along with coordination between the various economic sectors, especially between the

agricultural and the industrial sectors. Other aims include the proper distribution of agricultural production activities to cover all the regions of the state. This last aim could be achieved by the proper development of productive power and by the encouragement of rural communities to engage with the agricultural sector, in addition to streamlining the agricultural economics in the right direction. Moreover it is important to concentrate on agriculture as a means leading to economic independence by using the available agricultural resources and by the implementation of modern scientific and technological techniques (Elgadi, 1997).

It would be more appropriate to conduct studies of the effects of the increase in production, as the result of development plans, on local and foreign demand and the possible implications for prices. Such studies could reveal the best ways for farmers to generate a suitable income, which would make them feel happy with the aims of the plan.

Yet, most projects within a certain plan need a considerable period of time before they can generate the outcome that is expected of them. Therefore planners of projects such as soil reform, or trial stations should design long term plans for these projects (Lutfi, 1997). In this respect, in order to avoid the duplication of activities, coordination between the various government institutions concerned with the agricultural sector is paramount. It is also necessary to gain accurate information about the human power available in rural areas, in terms of its status, composition and problems, and also information about prevailing traditions and

values. All this information would be useful to the agricultural project at some stage during planning and implementation. Also, this information should assist in managing the human resources in such a way that would make its utilisation possible (Ismail, 1991).

Furthermore, the development of educational and health institutions is of vital importance to agricultural development plans. These institutions are the means by which the social lives of farmers can be improved, so that communications between urban and rural areas will be made easier, closing the gap between the two communities (Elnagefi, 1987).

It is evident that the development of human power in the production process is an objective condition for the success of the development plans in any economic sector. Therefore flexibility becomes a requisite when managing such plans. This implies that the plan has to be reviewed on a regular basis in order to make whatever changes are necessary along the way in the light of the ever-changing circumstances. This will allow the planners to avoid the effects of mistakes made during the course of its execution.

The foregoing are the most important points that must be taken into full consideration when planning for agricultural development aiming at changing the socio-economic reality in rural areas in favour of the local population.

This chapter discusses the agricultural development, the importance of agriculture, the role of agriculture in economic development, economic development and agricultural growth, agricultural development in the third world, the obstacles to agricultural development in developing countries and theories of economic growth.

2.2. Agricultural Development

In most third world countries, people suffer from various problems. One of the reasons for people in these countries lagging behind in the field of agricultural development is that they fail to use the available resources in a way that helps the agricultural sector to contribute effectively to the national economy and to boost economic development (Ismail, 1991). The following points highlight some of the problems facing agriculture in these countries (Elnajefi, 1987)

1- The prevailing old feudal and tribal relationships and the unfair distribution of land in these countries.

2-The slow development of productive power, the low productivity per unit area and the low capital investment in the agricultural sector.

3- Prevailing government policies that aim at production for local consumption rather than for export.

4- Lack of employment in rural areas, apart from menial jobs.

5- The low income of the work force in rural areas.

6- The weak contribution of the agricultural sector to the national income.

7- The widespread disease, poverty and illiteracy among peasants whose contribution to any anticipated agricultural development plan is vital, otherwise the whole plan will collapse.

However, besides modern technology, the training and development of the human power to use this technology and other resources in rural areas efficiently is vital for the achievement of agricultural development (Salah Eldin, 1993).

Therefore, it is a foregone conclusion that the aforementioned problems cannot be overcome in those countries by chance, but rather by the implementation of certain policies and measures that could lead to the overcoming of those problems, and to the consequent development of the production power in rural areas. This will make the agricultural sector move forward and will actively play its role in the economic development as a whole.

From the foregoing, it can be said that the agricultural development plan must consider all aspects of development relevant to the agricultural sector. Therefore agricultural development is a process that should to consistent increases in the income of the rural population, to fairness in the distribution of wealth, and to adopting the right policies that allow the agricultural sector to assume its vital role in the overall economic development plan. This process will ultimately boost the productivity of the agricultural sector (Mahy Eldin, 1975).

Therefore, in order to liberate the productive powers in rural areas, policies for agricultural development in under-developed countries should target the termination of traditional patterns of exploitation in production relationships. Consequently, this will boost production per unit area, and will also increase the income for the rural population besides leading to a fair distribution of wealth among them, which will ultimately contribute to the socioeconomic welfare and prosperity of the communities (Elshafe, 1991).

2.3. The Importance of Agriculture

The vital role of agricultural development in the overall economic development of a country is obvious. This can be judged by the role of agriculture as a vital production sector in the national economies of different countries worldwide. Therefore it is necessary to consider the importance of agriculture, in general, to socioeconomic life before discussing the role of agricultural development (Elnajafi, 1990).

From a historical point of view, it is evident that economic growth in any country cannot be achieved without achieving a considerable degree of efficiency in the agricultural sector. Hence agriculture as a production sector should integrate with other economic activities, as these activities are more or less interrelated, whether directly or indirectly.

However, agriculture is indispensable for the continuity of life, as it is the source of human food. This explains why boosting agricultural production in rural areas is the core of economic policies in many countries in the world. Furthermore, agriculture is counted as an important earner of foreign exchange. In the event of the failure of the agricultural sector to meet the needs of the society for food materials, then the state will resort to importing these materials. This will be at the expense of other vital imports, which will burden the national budget, especially in underdeveloped countries. Also, the huge tax revenues generated by agriculture will be an important source of funding for other economic activities.

In third world countries agriculture is the main tax generator, where the tax revenues are used for funding social projects, the military and many other projects. Moreover agricultural reserves are also a second source for funding other economic activities, although these reserves are affected by a number of economic factors, such as the prevailing production relationships, the procurement system, income and production, besides the agricultural technology in use, the savings of farmers and the distribution of wealth. In summary, agriculture as a production activity is paramount in the national economies of different countries. Therefore boosting the efficiency of the agricultural sector, especially in developing countries, is an urgent issue. This urgency stems from the fact that the development of the agricultural sector is an objective prerequisite for industrialization in particular and economic development in general, for the following reasons:

1- In the early days of capitalism, the highly developed countries could fund the industrial sector through agricultural development, at the expense of the rural population. Economic reserves were also used for funding the inefficient industrial sector. The current status of the developing countries implies that these countries should pay attention to boosting their agricultural production, so that part of the economic surplus could be used to improve the economic conditions of farmers, and the rest of this surplus for funding the ever-demanding industrial sector.

2- Changes in consumption patterns are very slow in the highly developed countries compared to the dramatic increases in consumption that characterize the developing countries due to the adoption of Western life's in these countries. This necessitates the adoption of certain policies in these countries aiming at the development, diversification and the restructuring of agricultural production.

3- The highly developed countries can easily find suitable markets for their products. The vast markets in their previous colonies have become a substitute for weak local markets. However, in the case of developing countries, the chances of finding suitable markets are very slim. The only option is to rely on local markets and to try to expand these markets. In this respect the agricultural development sector has a crucial role to play in creating the required markets for its products.

4- Industry in the highly developed countries has succeeded in accommodating surpluses in the workforce, whose growth is very slow given the slow population growth in these countries. In contrast, in the developing countries the industrial sector cannot cope with the fast growing population, and therefore unemployment is always liable to rise. Hence the only alternative for these countries is to create

jobs by developing the agricultural sector and by simultaneous urban and rural industrialisation (Hammadi, 1989).

The above are the most important trends which make agricultural development an urgent issue, as related to the question of the overall economic development in developing countries.

2.4. The Role of Agriculture in Economic Development

After discussing the importance of agriculture to the national economy and the need for developing this sector, it is appropriate to outline the possible role of agricultural development in achieving the overall economic development in developing countries. The most important indicators of this role are:

1- Achieving internal and external economic balance. The lack of agricultural production may create a state of imbalance between supply and demand in industrialised societies. This will lead to inflation, which is reflected in the persistent increase in the prices of consumer goods as well as other goods that depend on agricultural raw materials. To deal with this problem a government is likely to resort to imports instead of funding development projects. With increasing imports and dwindling exports the balance of payments will be affected. Even with increasing agricultural production, a great part of this will be consumed locally due to high demand in both rural and urban areas. The only solution is another source of foreign exchange to maintain the balance of payments, and yet

the budget will still suffer from huge deficits. These deficits will affect the agricultural sector and render it incapable of meeting consumer demands, and make it ineffective in overall economic development. This situation will also lead to abuse of limited natural resources.

2- Dealing with the increase and changes in the patterns of consumption. The need to boost economic development raises the demand for food to cater for the growth in population and subsequent increases in consumption. In this case the developing countries have to deal with almost double the population growth compared to the highly developed countries, estimated at 1.5% on average. Hence the economic development will be meaningless if it does not target the promotion of living standards by increasing people's incomes. However, it is a common phenomenon that increases in income will lead to increases in spending on food materials. Also consumption of food materials increases as a result of population growth in cities and the increase in spending among farmers given their improving socioeconomic conditions. In this case demand for low quality and cheap food materials, such as synthetic food and cereals will diminish. In contrast the demand for high quality and expensive food, such as fresh meat, dairy products, fruit and vegetables, will increase.

3- Funding the development plans. At certain stages of the socioeconomic development of a nation, agriculture will assume its distinctive role as the main source of national income. However, with the progress of economic development, the role of other economic activities will become more important in the generation of national income.

Yet agriculture will still have a major role to play in the development of other economic sectors. This role can be perceived in the importance of agricultural reserves in the funding of other sectors, and in supplying their workforces with the necessary food materials.

4- Supplying fledgling industry with raw materials. Agricultural products are the basis of many other industries. Therefore, the availability of these products, as raw materials, is a prerequisite for establishing these industries. For example, meat, sugar, fruits and vegetables are all essentials for the food industry, and also medical herbs are basic in many vital industries (Johnston and Mellor, 1961; Ranis et al 1990; Delgado et al, 1984; Timmer, 1995).

5- The availability of the workforce and of suitable markets for the new industry. Industrialisation depends upon many factors. One of these factors is the availability of workforce. Overproduction by the agricultural sector will lead to the redundancy of some of its workforce, which can be employed by industry if the population growth fails to provide the necessary workforce. Also the fact that labour in the agricultural sector tends to be underpaid compared to that in industrial sector will have positive effects on production costs for the industrial sector. Consequently prices will be less, and this will increase the chances of local production competing with imported goods. Also low production costs will increase the competitiveness of local products in international markets. Moreover, the transfer of labour from the agricultural sector to the industrial sector should increase productivity for both sectors, which is a prerequisite for economic prosperity. The prevalence of such conditions may lead to improvements in skills, and, as a result, products from the

two sectors will flood the market and the balance between the use of capital and employment will be maintained (Najafi, 1990).

Therefore, agricultural development plays a key role in the development of the productive powers of the agricultural sector, and will enhance the social activities in this sector. This will create the right environment for specialisation and the proper distribution of agricultural production across the country.

Growth in agricultural production contributes effectively to improving people's incomes, to the development of industry, and to the modernisation of rural areas in order to catch up with urban areas. Furthermore the improvement in transport between cities and rural areas will improve marketing opportunities for the industrial products in rural areas, and this will encourage and motivate the process of industrialisation. Also, income generated from agriculture will tend to improve the chances for farmers to produce more cash crops, and this will bring the two sectors closer in terms of exchanging benefits. This will finally pave the way for the integration of agriculture with other economic sectors to the benefit of the local and international economies.

2.5. Economic Development and Agricultural Growth

Economists who highlight the production, distribution, and consumption of goods and services have conducted much work on agricultural development. The factors of production from the economist's point of view are capital, natural resources,

human resources, technological development, and entreperneurship. The natural resources are mainly land, raw materials, sources of power, and atmospheric condition. The composition of the population, the size of the labour force and its skills, and mobility, and the psychological attitudes of the population describe the human resources. The technological component is composed of machinery and equipment, technical processes, and industrial power.

As seen by some scholars, economic development involves a major transformation of the economy from one that is predominantly agricultural to one containing a large and growing urban-industrial sector (Jorgenson, 1961; Mellor, 1962). This economic transformation is generally necessary for overall economic development.

In blueprints for economic growth according to some scholars, the agrarian sector throughout a country has received only secondary attention and has often been allowed to languish (Weinbaum, 1982). Using advanced industrial countries of the West as models, an essential remedy for an underdeveloped country's economic backwardness is capital accumulation to provide for rapid urban-industrial expansion and competitive exports. It has been argued that

"Public investment in heavy industry, as well as in, communications, promised the desired national self-determination, while an agriculture-dominated economy supposedly sentenced a country to an impotent future" (Weinbam, 1982, p. 23).

Improvements in agriculture, along with adequate transportation and storage facilities, are essential for increased food production per area per worker. Increased food production plus better sanitation and improved medical technology has been largely responsible for the reduced death rate, firstly in Europe, and then in the rest of the world. Moreover, agricultural productivity is often seen as a key index of a nation's economic self-sufficiency as well as important for the health and well being of the population. This is particularly true of the less industrialized nations where agriculture makes up a very large share of the gross national product. Additionally, there is increasing recognition that agricultural development is often a stimulus for other forms of development.

Therefore, the crucial role of agriculture in earlier stages of economic development received considerably more emphasis in recent years from some economists. Part of this emphasis was certainly a reaction against what some authors feel is an unwarranted stress on industrialization. Among economists placing a high priority on agriculture were Viner (1958), Rostow (1960), and Nicholls (1963). Others, notably Lewis (1964), Ranis and Fei (1961), and Johnston and Mellor (1961), emphasized the general characteristics of agriculture in underdeveloped countries and drew attention to the important role agriculture may play in the growth process (Mellor, 1968).

"In an effort to stimulate agricultural development, a Western model was often drawn upon. Agricultural production in Europe and the United States had undergone a radical transformation in the twentieth. Scientific methods of cultivation were introduced and mechanized equipment and other industrial products became widely used" (Boserup,

1965, p.116). Boserup noted that given the background of the technical revolution of agricultural procedures in the already developed world, agrarian change in underdeveloped countries may seem trivial. It is, therefore, understandable that many economists should presume that in countries where agriculture has not yet reached the stage of scientific and industrial methods, it is still stagnant and traditional.

"One might object that the recent revolution in agricultural techniques has changed the situation in this respect and that an additional solution is now available; namely, to modernize and increase food production by means of industrial input and mechanized equipment as well as chemical fertilizers" (Boserup, 1965, p.120). But, the modest increases in output per man-hour that can be obtained by the use of industrial products or scientific methods in some communities may not be sufficient to pay for the very scarce resources of skilled labour and foreign exchange which they absorb. "Unlike the majority of developed capitalist and socialist countries, the developing countries still will not be able to manage to achieve self-sufficiency in food products in the near future. Most developing countries take the stand that the decisive part of the demand for solvency should be met out of national production" (Kiss, 1979, p. 77). "According to most forecasts, the growth in production will be decisively met by the growth of intensive methods of production, since possibility of increasing cultivatable land (the extensive method) is rather limited in most developing countries" (Kiss, 1979, p. 82).

"Part of the difficulty in explaining and stimulating agricultural development is its complex nature. Mosher defines agricultural development as the process by which the

activities of people cultivating the soil and tending livestock become more productive" (Mosher, 1964, p. 339).

It has been argued that a theory of agricultural development must give attention both to ways of increasing agricultural production within its traditional structure and to the means and consequences of its modernization. A fully developed theory of agricultural development, according to Southworth (1968), must take into consideration four important interactions between agriculture and nonagricultural sectors. Firstly, "there is a major relative shift of the labour force from the agricultural to the nonagricultural sectors. Secondly, the creation of nonfarming jobs requires a large increase in capital in the urban sector. Thirdly, a thriving agricultural sector may provide needed markets for the industrial output of consumer goods; and fourthly, highly productive agriculture depends on inputs originating outside the agricultural sector" (Southworth & Johnson, 1968, p. 24).

Narrowing our focus, the problem of agricultural development, as seen by several scholars (Hayami & Ruttan, 1971; Mellor, 1968), is not that of transforming a static agricultural sector into a modern dynamic sector, but rather, accelerating the rate of growth of agricultural output and productivity. Consequently, "a theory of agricultural development should provide insight into the specific dynamics of agricultural growth. In this respect, the literature on agricultural development has focused generally on four approaches: (1) conservation, (2) urban industrial impact, (3) diffusion, and (4) the high payoff input model" (Hayami & Ruttan , 1973, pp. 297-300).

The conservation model of agricultural development evolved from advances in crop and livestock husbandry associated with English agricultural developments, and concepts of soil exhaustion suggested by early German soil scientists (Hayami & Ruttan, 1973).

The conservation model emphasizes the evolution of a sequence of increasingly complex land and labour-intensive cropping systems, the production and use of organic manures and labour-intensive capital formation in the form of physical facilities making the use of land and water resources more effective.

Von Thunen (1966) formulated the urban industrial impact model to explain geographic variations in the intensity of farming systems and in the productivity of labour in an industrialized society. Later, T.W. Schultz (1971) explained the more effective performance of the factor and product markets, linking the extension of agricultural and nonagricultural sectors in regions characterized by rapid urban industrial development.

This model has received only limited attention in the less developed nations. The diffusion model of agricultural development, which identifies major sources of productivity growth even in premodern societies, rests on the empirical observation of substantial differences in land and labour production between farmers and regions (Roger, 1969). This emphasizes effective dissemination of technical knowledge and a narrowing of the differences of productivity among farmers. This model has provided the major intellectual foundation for much of the research and extension effort in farm management and production economics since the emergence of agricultural economics in

the last century. However, the limitations of the diffusion model as a foundation for the design of agricultural development policies became increasingly apparent as technical assistance and community development programmes, based on the diffusion model failed to generate either rapid modernization of traditional farms or rapid growth in agricultural output.

The inadequacy of policies based on the previous three models has led, more recently, to a new perspective- the high payoff model- showing that the key to transforming a traditional agricultural sector into a productive source of economic growth is the evidence of an order of magnitudinal increase in investment designed to make modern high payoff inputs available to farmers in poor countries. The new high payoff inputs can be classified into three categories: (1) development of the capacity of public and private sector research institutions to produce new technical knowledge; (2) development of the capacity of the industrial sector to develop, produce, and market new technical inputs; and (3) increasing the capacity of farmers to acquire new knowledge and use inputs effectively (Schultz, 1964).

"It has been observed that the significance of the high payoff input model is that policies based on the model appear capable of generating a sufficiently high rate of agricultural growth to provide a basis for overall economic development consistent with modern population and income growth requirements" (Hayami & Ruttan, 1973, p. 301). It has been argued that the unique implication of this model for agricultural development policy is that it embraces not only the central concepts of the previous three models, but also it

emphasizes accelerating the process of development of new inputs, or techniques, through public investment in scientific research and education.

Alternatives to traditional models of development through investment priorities are identified in the "high payoff model". Technology can be developed to facilitate the substitution of relatively abundant factors for relative scarce factors in the economy. Constraints imposed on agricultural development by an inelastic supply of land and absence of opportunities for horizontal expansion have been offset by the development of high yielding crop varieties designed to facilitate the substitution of fertilizer or land. The constraints imposed by an inelastic supply of labour have been offset by advanced technology leading to the substitution of animal and mechanical power for labour (Schultz, 1966; Hayami & Ruttan, 1971; Ahmad, 1966). Indeed, the literature shows that

> "there has been a close association in biological technology; and between advances in output per worker and advances in mechanical technology" (Hayami & Ruttan, 1973, pp. 303-305).

Given the above four approaches to agricultural development, it is clear that Libyan officials are using the high payoff model because thy carry the major responsibility for the agricultural development programmes in the whole country in planning financing, consultation training programmes, and marketing the farmers` production. Additionally, the Libyan officials aim to increase the farmers` capacity to acquire new experience and to improve their standards of living. The extensive resources from oil revenues in Libya have encouraged officials in the country to move towards modernization of the country in general, and in agriculture in particular. At the same time, by focusing on the payoff

model, we believe that Libyan officials are trying to become self-sufficient in food production, and therefore they aim to minimize their dependence on the developed countries as sources of their food requirements in the near future.

During the 1970s, the application of the high impact model would have appeared to be particularly successful in certain less-developed countries. This was the era of the "Green Revolution" based upon the development of new seed varieties, their adoption and utilization in favourable situations (Kiss, 1979; Hewes, 1974).

However, the success of the "Green Revolution" in selected regions of the world has tended to make some policymakers overly optimistic about its remarkable impact, but simple adoption of new seed varieties which have been pioneered by the wheat research institute in Mexico and the rice research institute in the Philippines is not a panacea for many other countries in the third word. Capital costs for irrigation systems, where adequate water supplies are available, are costly. The costs of fertilizers, particularly in view of rising energy expenses, pesticides, and insecticides, also limit effective and widespread utilization of the new hybrid seeds. Moreover, the process of agricultural development is complex and does not simply rest upon the utilization of new seed varieties. This is evident from historical experience in the Western world.

If we look at the literature which deals with agricultural productivity, we note that the economic models of agricultural development are not exhaustive. One may observe that there are generally three approaches, which are equally important to explain variations of productivity: (1) the economic approach which emphasizes the forces of productivity,

farm size, and the labour force; (2) a sociological approach which emphasizes adoption of innovation, farm cooperation, and extension services; and (3) a psychological approach which emphasizes adjustment to the social milieu, and then farmers` social interactions in their neighborhood.

Regarding the economic approach, one may find that the bulk of the literature particularly from economists and agronomists deals with and emphasizes the importance of this approach to the neglect of others. Economists argue that "theories of agricultural development which may be represented by a production function depicting agricultural output as a function of various inputs are some times used in traditional and modern agriculture alike, in other cases are used only in modern agriculture, and in still others are used only in traditional agriculture" (Southworth & Johnston, 1968, p. 46). The new inputs of modern agriculture are largely of an institutional nature, including research centres, training programmes, and educational facilities.

National resources, such as fertile land, water supplies, a suitable climate, and modern technology, are generally the main source of productivity from the point of view of economists. Mosher (1966) argued that in order to get agriculture moving in the direction of higher levels of productivity, we must think of improving and expanding agricultural land, planning for agricultural development, introducing modern technology, and increasing levels of education and training programmes in agricultural schemes.

The Libyan case, to a large extent, mirrors this approach. The public sector provides farmers with most of the facilities needed for agricultural development. The government has the financial resources and the intention to improve agricultural productivity; but some of the problems which handicap these efforts might be related to the availability of training programmes and/or the farmer's ability to use the modern technology. Additionally, there are other problems. The majorities of farmers may be illiterate or have had no experience in agriculture in the past.

2.6. Agricultural Development in the Third World

This section discusses agriculture development in the third world, but before doing so, it essential to more precisely specify what we mean by agricultural development in an operational sense.

Where our focus is on increasing the individual or group contribution of agricultural units to the total output of a nation's agricultural sector, agricultural development is best reflected in productivity; that is, the output per worker in the agricultural sector. Output is easily measured in terms of the quantity of the products harvested annually, and where the system is tied to a monetized economy, an effective measure of productivity is the income generated annually.

Whether one uses volume of production or income generated by production, it is evident that changes in production represent an appropriate measure of agricultural development, for it is the differences in output per worker which tends to distinguish

the farmer in the developed western world from the farmer in the developing nations.

In India, for example, agricultural output per worker is approximately one-fiftieth of that in the United States. Relatively few underdeveloped countries have achieved levels of output per worker one-fifth as high as achieved in the United States (Kiss, 1979). Furthermore, the productivity gap has widened during the 1960s, creating a serious brake on overall, relative economic progress (Hayami & Ruttan, 1973).

In addition to other considerations, it is important to recognize that overall productivity, and thus average productivity assuming stability in the size of the agricultural labour force many arise through two types of agricultural expansion; singly or interdependently. These two types of expansion are described as vertical and horizontal. By vertical expansion, we mean the improvement and conservation of soil within a fixed farming area, the application of fertilizers, the control of insects and plant disease, the introduction of new crop varieties, and the use of agricultural machinery to increase productivity. By horizontal expansion, we mean reclaiming more land for agricultural purposes or expanding farm size. Below, we discuss some of the features and problems of programmes which emphasize vertical expansion, and others which emphasize horizontal expansion.

The most successful forms of vertical expansion are seen in those developing nations viewed as models for the "Green Revolution". The term "Green Revolution" is used to describe a remarkable order of magnitude of increase in agricultural

production in selected countries or regions. The starting point of the Green Revolution was the use of wheat, rice, and maize varieties especially bred for particular climatic conditions. In addition to being ecologically adaptable, the seeds were particularly responsive to relatively higher amounts of mineral fertilizers, purposeful irrigation, modern land utilization and cultivation methods, and the heavy application of pesticides and insecticides (Voigt, 1979).

The benefits of the Green Revolution have not, however, been equitably distributed. The Green Revolution is dependent on relatively heavy capital investments, which are most effectively spread over relatively large land holdings. The masses of small farms and tenant-operated farms, particularly in Asia, have not benefited from the Green Revolution. And this means that often a majority of farmers are excluded from the process.

In the economically "poor" population" rich" countries, most of the farms are small in size, and the farmers lack modern technology.

The farms are largely family subsistence operations. The plantation, the collective, the corporate farm, and the large family-operated farm of the type one finds in the capitalist nations.

This means that world agriculture, in general, is basically dependent on small farms.

The small size of land holdings in the developing countries is not the only geographic constraint on increasing farm productivity through vertical expansion programmes. Even the small land holdings are often fragmented. There may be poor tenure arrangements, low levels of husbandry practices, and parasitical credit facilities. However, the absence of technical skills and access to credit facilities sustain the stagnation among most peasant, or poor subsistence farmers. The fruits of the Green Revolution fell to a minority of farmers with relatively large land holdings.

Yet, if agricultural productivity is to be increased in the developing countries of the world, some method of eliminating the constraints on development generated by small and fragmented land holdings must be adopted. The solution is, in part, horizontal expansion. While we have utilized this term above specifically to refer to the development of additional land holdings, this can, of course, be achieved in a variety of ways through land reform, and redistribution, as well as land reclamation. We note, of course, that horizontal expansion is likely to be a major cause of increased productivity only if linked to effective vertical extension programmes. In most of the developing nations of the world the only possible form of horizontal expansion involves land reform, land redistribution, and in a few cases, the development of cooperative farming projects.

The Middle East nations, including Libya, represent, however, a particular case in which population densities are relatively low and opportunities exist for new projects which encompass both land reallocation and reclamation.

It would appear, therefore, that while most agricultural development programmes must be dependent, to large extent, on vertical expansion programmes, these programmes will be enhanced if tied simultaneously to horizontal expansion programmes. For many areas in Central and South America, as well as in Africa and Asia, this will involve primarily land reform and land redistribution or the development of some types of cooperative programmes. The Middle East is, therefore, somewhat unique in having many countries such as Libya with a low population density and the potential for land reclamation given adequate inputs. It is this particular case of agricultural development which is the focus of this research.

2.7. Obstacles to Agricultural Development in the Developing Countries

The process of agricultural development in the developing countries faces a number of obstacles that are likely to weaken the base of agricultural production and delay its growth. However, some of these obstacles are related to the natural and technical aspects, whereas others may be due to socio-economic, financial or organisational causes. These obstacles can be summarised in the following points (The Arabic Economic Report, 1989).

2.7.1. Natural Obstacles

It has been obvious that the natural habitat in the developing countries in Asia, Africa and Latin America has a great bearing on agricultural production and development with respect to the distribution of rain, drought, temperature, and natural disasters as well as the nature of the land and the associated soil in these countries. However, as a matter of fact, the average temperature in the majority of these countries is estimated at 20 C or above, which will affect the productivity of the workforce according to studies conducted in a number of regions in the developing countries, These studies have indicated that the productivity of a manual worker may drop to half with temperatures as high as 35 degrees, which is very common in tropical regions (Aziz, 1983).

Moreover, mosquitoes and other insects, and the myriad microbes and fungi associated with these insects add insult to injury by attacking plants and destroying stored crops. Also, other insects such as desert locusts tend to attack farms, destroying crops (Wahbi, 1987). However, most regions in the developing countries suffer from regular seasonal droughts, floods and fluctuations in annual precipitation ranging between 15-20%, whereas in the arid and semi-arid regions the rate of change may be up to 40% or more in the case of badly hit years, leading to crop failure.

Drought, floods and typhoons are the most dangerous and damaging factors to which tropical regions are exposed. Moreover, earthquakes and volcanic eruptions

mainly associated with the developing countries tend to hamper agricultural development. These natural disasters tend to incur huge costs for poor countries, claiming lives and squandering resources every year. Therefore it becomes quite normal that these natural disasters add to the plight of the already poverty-stricken developing countries by disrupting their development (Aziz, 1983).

Yet another problem faces these countries, particularly those lying within the dry desert zone. These countries lack sources of soft water, as the water available is highly saline. Further problems include deforestation in some of the developing countries, and the poor porous soil adds to the obstacles that hamper agricultural production in these countries (Baddran, 1989).

Hence, it is obvious that the low human and soil productivity in the developing countries is closely associated with the physical and natural environment which constitutes a major obstacle to development in these countries (Wahbi, 1987).

2.7.2. Economic Obstacles

Agriculture in most of the developing countries is facing some difficulties, which render it incapable of achieving its objective, and yet problems are not unique, and they differ from one country to another. However, in general these difficulties include the following:

2.7.2.1. Inadequacy of Savings Agencies

Most of the developing countries are characterised by inadequate capital, which is a major element in the production process. This capital has great bearing on the technology used in the production process. This is simply because organisers and investors always tend to reduce the risks associated with agricultural development by introducing modern production methods and expanding plant and animal farming projects to meet the increasing demand for basic food products such as cereals and meat. Yet, these investors in the developing countries are not provided with the necessary loans to do the job. This is due, in the first place, to the inadequate savings of individuals in these countries, and therefore the malfunctioning and inefficiency of the monetary institutions, and the failure of their managements to provide the necessary assistance to investors (Najafi, 1987).

This problem of savings is associated with per capita incomes in the developing countries, which tends to reduce the saving gradient and increase the consumption gradient. Consequently the greater part, if not all, of any increases in individual income whether related to increases of the national income or to any other external source is likely to be consumed, given the low per capita income. However, in most of the developing countries, especially in Africa, this per capita income may be close to the poverty line, producing adverse effects on the savings capability of individuals. Moreover the level of individual savings usually reflects the size of national savings, which in the case of developing countries will not be sufficient to provide a suitable source of capital to support the national economy especially in

the non-oil countries. This will eventually reduce the chances for the accumulation of the capital essential for agricultural development.

2.7.2.2. Farming Capacity

This is measured by the abundance of the elements available for farm production. This abundance is variable from region to region even within the same country, and yet it is mainly dependent on the technology used as well as managerial efficiency. These two variables, if sufficiently available, will usually lead to the multiplication of farm productivity.

This characteristic is dependent on a number of variables causing an increase in returns that tend to decrease at later stages. However, failure to achieve the ideal farming capacity in most of the developing countries is mainly due to the complicated land ownership system, which may amount to either feudalism or a mere fragmentation of the land (Najafi, 1987).

Therefore under these circumstances of land ownership, agricultural cooperatives become important in creating sizable farms by assembling the land.

Of courses, complicated land ownership is more likely to disrupt agricultural development. Furthermore, unfair land distribution in the developing countries is likely to create an unfavourable regime that hampers production growth.

However, despite variations in land ownership in the developing countries, most of these problems are nonetheless related to the complicated and fragmented land ownership, which makes it difficult to achieve proper agricultural development and production growth to meet potential demand.

2.7.2.3. Population Growth and the Land

Most of the developing countries are categorised in the second stage of the population growth, which usually passes through three stages. These stages include the initial primitive and isolated stage, where the economy is completely independent of the international economic relationships. However, the high mortality and birth rates characteristic of this stage are likely to produce population balance and stability. In contrast advanced healthcare, the eradication of endemic diseases and the discovery of a number of antibiotics have tended to lower the annual population growth in the second stage from 4% to 2%. On the other hand, advanced healthcare in the third stage, especially in relation to contemporary diseases, tends to reduce the mortality rate at this stage to only 1% while the birth rate remains the same at 4%. This makes the population growth rate stay at 3%, which is the maximum limit for normal rates of increase (Aziz, 1983).

However, most of the second stage countries are characterised by the high population density per unit of arable land such as is the case with Egypt, and India and similar countries.

The population explosion in these countries tends to reduce the area of arable land per person, while the increase in population density with respect to arable land will result in the decline of income as well as productivity, provided the other variables are constant. These two factors are likely to reduce savings and potential investment in agriculture, and again will lead to the lowering of agricultural income, which is a vicious circle that develops with time if left untreated (Mhay Eldin, 1975).

A continuous population growth without a proportionate increase in the cultivated area will result in what is known as a surplus of labour, or disguised unemployment. This poses a serious obstacle to agricultural development, particularly because it affects the formation of capital, since the part of the society that does not contribute to production will live parasitically on the other productive part.

Moreover, population growth will also lead to the increase in demand for basic consumer goods, and eventually this will take place at the expense of investment and productivity. Yet, in some cases where the local agricultural sector fails to meet the increasing demand for basic consumer goods, the bill of imports for these materials will rise to cover the deficit (Ismail, 1991).

2.7.3. Technical Obstacles

These include all factors related to the requirements of agricultural production and agricultural processes as outlined in the following points:

2.7.3.1. Type of Seeds

Most developing countries suffer from using the types of seeds that are vulnerable to disease and insects and that cannot cope with the prevailing environmental conditions.

2.7.3.2. Requirements of Agricultural Production

In most developing countries, agricultural processes tend to be primitive so that the use of modern technology such as chemical fertilizers, insecticides, machinery and other agricultural equipments is very rare.

Even though the use of fertilizers is uncommon in most developing countries yet, the type and pattern of the use of these fertilizers is another problem. This problem is mainly related to the un-rationalised use of these fertilisers as well as their improper their improper use with respect to the requirements of the plants. However, a number of factors make these fertilizers unavailable for use in the developing countries. Most importantly they are cost prohibitive; besides which there is a lack of supervision regarding their importance for production, which constitutes an obvious obstacle for agricultural development in these countries.

Also, the improper use of insecticides and fungicides with respect to the type and the timing of the spread of insects will affect the potential crop production. Moreover there is a palpable lack of agricultural mechanisation in the developing countries, which is basic to modern agriculture and which has led to the contemporary revolution in the business. Therefore these three variables, i.e. fertilizers, insecticides and mechanisation, if improperly or inefficiently used, will definitely result in low crop productivity as well as limiting both horizontal and vertical expansion of agriculture in the developing countries (Najafi, 1987).

2.7.3.3. Agricultural Processes

All agricultural processes in the developing countries including land preparation, ploughing and seeding and the subsequent battle against weeds, insects and diseases, the use of fertilizers are characterised by inefficiency and delays, resulting in low crop production .

2.7.3.4. Agricultural Workforce

In the developing countries the workforce is characterised by poor experience with regards to the use of modern production techniques. This makes this workforce limited to the traditional methods, which hamper agricultural development programmes.

2.7.3.5. Marketing and Related Problems

Marketing is deemed as a complementary service to agricultural production. Again these processes tend to be inefficient as well as inconsistent in the developing countries, in terms of the methods used at the different stages of the marketing process, such as the storing and sorting of products. This will eventually result in the loss of or damage to a great part of the potential crop production. Moreover, exporting facilities, such as methods of transport, are also inefficient, constituting a main obstacle to agricultural development. However, in some of these countries the process of marketing the crop production in central markets becomes logistically difficult, causing the farmers to limit their production to self-sufficiency in a few cash crops. This kind of traditional agriculture tends to restrict production, disrupting agricultural development in these countries (Najafi, 1987)

2.7.4. Institutional and Organisational Obstacles

These include the policies related to the prices of agricultural products. However, the fact that agricultural crops usually constitute the main food commodities for the people makes rational policies related to the prices of these commodities a prerequisite for achieving economic prosperity, and which greatly affect the rates of agricultural development. Nonetheless, in all developing countries it can be noticed that the pricing policies are partial in the sense that the policies do not reflect the prices of all the components used in the agricultural sector as well as other sectors. This renders pricing policy an obstacle in the course of agricultural development, as it will not encourage production.

2.7.5. Miscellaneous Social Obstacles

Some social customs and traditions, religious taboos and the ever-deteriorating social status of farmers in the developing countries, constitute a huge burden on the development of the agricultural system. However, the only solution for this problem is for the government to undertake a long-term commitment to educate the farmers as well as improving their technical skills. To be more precise, this will imply the introduction of a profound structural reform to the rural areas in general and to agriculture in particular (Ismail, 1991).

Moreover, population growth is a problem per se and agriculture has to cope with this growth to produce the essential food materials in demanded. Yet, this problem cannot be tackled without the proper planning by increasing production on the one hand and the restructuring of the agricultural system on the other hand, in order to achieve the right balance between population growth and production. However, this will depend on the adequacy of a technically skilled workforce.

Furthermore the prevailing religious beliefs and social traditions also constitute important factors that determine the nature of the workforce in society. These prevailing religious beliefs and traditions in the family or tribe tend to affect both production and distribution systems. The religious beliefs and the associated views on what is taboo and what is allowed also have a critical effect on production and on the standard of living.

For example, the worship by the Hindus of the cow makes their slaughter a taboo. This has a main bearing in the increase of the cattle population in India. Therefore it can be maintained that the people of India do not use animals as a sustaining economic source.The same can be said about pastoral societies where people decline to settle down and engage in agriculture.

2.7.6. Other Obstacles

Political instability and internal feuds in the developing countries tend to delay agricultural development plans. Hence, these adverse conditions for development play a major role in keeping these countries langging behind and confined to the cycle of destitution. However, the main reason is that due to the previously mentioned conditions prevailing in these countries, local investors will lose trust and prefer to smuggle their money out of the country rather than investing in agriculture. Also money and savings are more likely to be spent on weapons instead of development. It is obvious that vast military spending hampers efforts for development in some countries (Ismail, 1991).

Finally it can be said that one of the most serious obstacles that hampers development in the developing countries is the waste of human power reflected in the rift between governments and the people. However, this kind of rift will keep people away from the development programmes, limiting their contribution and decreasing their productivity.

2.8. Theories of Economic Growth

The classical analysis assumes that the process of economic growth takes place within the capitalist production relationships. This takes the form of a race between technological advancement and the progressive growth in population. However, it is likely that technological advances in the means of production overtake population growth for a certain period of time, but afterwards a sustained growth in population will tend to impede the process of economic growth. The classical analysis, however, aims at identifying the reasons for the long-term economic growth of the national income and methods for achieving that.

The classical analysts identify three elements of the national income, which are wages, rent and profits. They believe that the process of economic development is greatly affected by these elements. Hence, they categorise products into agricultural commodities and manufactured commodities. Then they try to discuss the advantages of economic policies with respect to their effects in boosting or hampering the process of economic development.

Adam Smith`s analysis of capitalist economies is characterised by his optimistic views. His ideas were based on the principle of the division of labour, linking this division with the size of the market and condoning savings as a political prerequisite for economic growth. He also condemned government intervention, as well as any effort aimed at impeding freedom of trade and free competition. According to Adam Smith, the advantage of capitalist economies can be attributed

to specialisation and the division of labour. These two features will raise labour skills and reduce production time as well as the time necessary for the invention of new production techniques. In addition, he suggests that increases in production will lead to the accumulation of capital and increases in people's incomes, as a result of the improvement of their living standards. Moreover the increase in production as well as the increase in population will lead to the expansion of the market, and raise the savings capacity, and also the potential for specialisation and the division of labour will become high. In the mean time Smith did not ruled out economic deterioration, and warned of possible economic recession in the long-term.

Yet, in his theory of income distribution, smith perceived that the worker's income depends on his bargaining power with his employer. Normally, in the case of stagnant economies, wages tend to decrease, whereas in the case of dynamic economies, wages tend to increase, due to the increase in capital and economic activities.

However, Smith linked the increases in the wages with both population growth and the rate of capital accumulation. Yet, he perceived profits as revenues of capital within the context of the process of economic growth. He suggested that profits tend to decrease with the accumulation of capital, which will lead to the increase of wages. This will continue until capital reaches the maximum allowed by the resources available. This will then bring the process of economic growth to a halt,

and at this point economic recession will take over. This will eventually result in low profits and wages will reach their nadir. However, Smith ruled out any economic recession in the short-term.

When Adam Smith wrote his treatise, only a small number of water-driven industrial establishments existed, and the Industrial Revolution had barely started. This helps to explain his conviction that agriculture and not manufacturing was the principle source of wealth (Blaug 1997). Smith considered the produce of the land as "either the sole or the principle source of the revenue and wealth of every country" (Smith, 1909, p. 627).

For Smith, agriculture was more productive than manufacturing because it was "two powers" concurred in its production, land and labour, whereas manufacturing has only one power (labour).

Theory of Adam Smith is not perfect. Its main drawback is the lack of organisation. Nevertheless his emphasis of the importance of capital accumulation for the process of economic growth is considered as a redeeming feature in theories that followed. Moreover, his views on economic recession have dominated classical thinking, and he has also been hailed for his ideas of a gradual and continuous process of economic growth.

Ricardo's theory implied a more pessimistic view, as he reversed the idea of increasing returns to decreasing returns. He suggested that the process of economic growth will eventually end in stagnant economic conditions, where there will be no increase in investment, profit or population. In his view the agricultural sector is of vital importance to the national economy. Even though, he seemed to be pessimistic in his analysis about the capabilities of this sector in securing sufficient amounts of food materials for a fast growing population. However, it appears that Ricardos' analysis ignored advances in technology and their positive effects in increasing the productivity of the agricultural sector.

In his analysis Ricardo, divided society into three classes, which are capital owners, landowners and workers. He believed that capital owners play a major role in economic activities by establishing manufacturing facilities and by providing the necessary equipment as well as the necessary workforce. Capital owners also help the process of capital accumulation by reinvesting the profits obtained, which will enhance the production process and lead to more employment. As for the workers, Ricardo believed that they are completely dependent on the capital owners who provide them with equipment to work with, and with wages to live on. He further predicted that wages will reach their minimum in the long-term, and after that any further decline in wages will discourage the workers from working. On the other hand, the increase in wealth, population and capital will lead to excessive use of fertile land and will push the farmers into infertile or bad land. Therefore, in such a situation, competition among farmers for fertile land will be in the landowner's

advantage, and they will eventually try to increase their share of the harvest. However, Ricardo refered to this phenomenon as "The revenues of using the original inexhaustible land forces" (Ismail, 1991,p.120).

Ricardo divided the national income into three parts: rent, profits and wages, which are allocated to the landowners, the capital providers and the workers respectively. Ricardo also differentiated, in his analysis, between the national income, which includes the cost of production and services within a certain period of time, and 'net income', which is the difference between the national income and the cost of the workforce in the same period of time. He also suggested that, in the presence of the capital and natural resources, the workforce will produce more than its cost and the difference will yield an economic surplus. However, he agreed with traditional thinking that this surplus is paramount to the process of economic growth as it adds to the invested capital. He also maintained that while the real wages of the workforce in advanced economies tend to decrease, profits will also decrease in the long-term. This can be explained by the fact that the accumulation of capital will temporarily increase real wages, but in the long-term the increase in population will tend to provide a cheaper workforce. Consequently this will negatively affect wages, which will slump to reach their minimum. Moreover the cultivation of infertile land will result in low productivity and higher prices. This will eventually increase the cost of living for the workforce, and lead to low profits for the capital owners, and then eventually to the reduction of the capital and of the national income. However, Ricardo believed that at this stage the whole economic

system will become stagnant and both population growth and capital growth will be brought to a standstill. He also believed that freedom of trade will make different countries enjoy the advantages of specialisation and the division of international labour. This will tend to increase international wealth through the efficient utilization of resources available in the member countries. However, Ricardo believed that interventions by local governments are sometimes necessary. Introducing tariffs in order to protect local production against imported goods can do this.

His pessimistic views, however, can be attributed to two reasons. First he assumed a principle of dwindling production, and second subscribed to the Malthusian theory of population. This theory argues that resources increase in arithmetic progression, whereas the population increases in geometric progression, which will put the former under pressure. Yet, it can be said that the classics have been over pessimistic in their views concerning dwindling production, as they did not pay attention to advances in technology, which can provide an absolute solution to this problem or at least reduce its effects.

Malthus devised a theory of population growth in which he explained poverty as a race between the growth in population and changes in the means of subsistence, thereby focusing attention on the limited supply of land. As the labour force increases, extra food could be produced only by extending cultivation to less fertile soil or by applying capital and labour to land already under cultivation, considering

the law of diminishing returns. Malthus was criticized for a variety of reasons: for example, his failure to acknowledge variations in the quality of land, the specifications of the time horizon, the availability of other resources, and improvements in technology and in production processes (Schumpeter, 1981; Walpole et al, 1996).

The neo-classical approach to growth and development has little favour in the modern political economy arena, as its appears distant from reality. In 1960, the American economic historian, W.W. Rostow, interpreted the economic development of nations in five chronological stages - from "traditional society" to "mass consumption society". Principally based on the neo-classical framework, he predicted that all nations eventually achieve the final stage but at different rates. According to Rostow, development requires substantial investment in capital. For the economies of LDC to grow, the right conditions for such investment would have to be created.

Many development economists argue that Rostows's model was developed with Western cultures in mind, and that it is not applicable to LDCs. In addition, the generalised nature of his theory makes it somewhat limited. It does not set down the detailed nature of the pre-conditions for growth. In reality, policymakers are unable to clearly identify stages as they merge together. Thus as a predictive model it is not very helpful. Perhaps its main use is in highlighting the need for

investment. Like many other models of economic development, it is essentially a growth model and does not address the issue of development in a wider context.

In paying special attention to the contribution of technology to economic development, Solow (1956) developed a model, which embodied technological change within factor substitution- giving this factor an important role in the determination of growth. In short, Solows` model of growth considers Harrod-Domar but adding technology as an exogenous factor explaining long-term growth. Savings, as the main engine of economic growth in Solows` model, transform the economy, freeing up sustained growth, and bringing about development in both economic and socio-political arenas. This model, however, fails to find a convincing answer to the question of under-development in certain high investing societies. This observation, coupled with protectionism, has led economists to concentrate on more realistic models of growth and development. In explaining and predicting phases of development, a group of economists led by Lewis in the 1960s developed a two-sector model of an economy with allowance made for "structural change".

In Lewis's model, the underdeveloped economy consists of two sectors: (i) the traditional overpopulated rural subsistence sector characterized by zero marginal labour productivity - a situation that permits Lewis to classify this as surplus labour in the sense that it can be withdrawn from the agricultural sector without

any loss of output; and (ii) a high productivity modern urban industrial sector into which labor from the subsistence sector is gradually transferred.

The primary focus of the model is on both the process of labour transfer and the growth of output and employment in the modern sector. Given the slightly higher real wages in manufacturing, however, the supply of labour is perfectly elastic. In order to entice labour into the manufacturing sector, capitalists pay a wage slightly higher than the agricultural real wage. The manufacturing wage is just high enough to compensate labour for relocation costs. Manufacturers realize a profit on production given this real wage. They plough back these profits as investment, thereby increasing capital stocks and the MPL, which leads to an increase in total productivity.

The model assumes that, with growth, manufacturers will not replace their existing technology with labour saving technology thus short-circuiting the employment process. The empirical evidence on lower agricultural wages is mixed at the very least. The assumption that real wages in the manufacturing sector are constant is not necessarily true—typically things like civil service wages, MNC hiring practices, and labour unions jack up wages in the modern sector.

In contrast to traditional neoclassical theory in terms of the final contributors to economic growth/development, the advocates of "endogenous" growth theory hold GNP growth to be a natural consequence of long run equilibrium, and hence

explain both growth rate differentials across countries and the greater proportion of growth observed. The most significant theoretical differences stem from discarding the neoclassical assumption of diminishing marginal returns on capital investment, permitting increasing returns to scale in total production and focusing on the role of externalities in determining the rate of return on capital investment.

It can therefore be argued that, "unlike the Solow model, new growth theory models explain technological change as an endogenous outcome of both public and private investments in human capital and knowledge-intensive industries" (Tadaro & Smith, 2003, 148).

In the light of this theoretical background, one may wonder where land settlement policy fits in. Land settlement is a strategy within a land/agricultural reform programme designed to develop the agriculture sector and hence promote the social welfare of the farming community. In effect, land settlement is a special form of a directed development programme in most developing economies.

2.9. Conclusion

Most economic analysts consider agriculture the principal, if not the only, source of economic prosperity. For example, Adam Smith (1776) perceived agriculture as having the edge over manufacturing by incorporating land and labour, which are two major economic powers. Hence, most scholars deem agriculture as the shortest way to achieve self-sufficiency in favour of the well being of the population.

However, agricultural planning is one of the means that leads to economic independence through the implementation of modern technology. Therefore, through proper agricultural development plans, farmers can increase their income. Nonetheless, in order to secure the success of these plans, coordination among relevant government institutions becomes an urgent matter. Moreover, information related to human resources and the prevailing social values are important elements for proper agricultural planning. The flexibility of the plan is another element of success, since it allows a regular review of the plan to cope with changing circumstances.

In developing countries, agricultural development constitutes the core of economic planning. Besides being the source of food, agricultural development is likely to generate huge revenues that can be used for the development of other economic sectors. Therefore, should agricultural planning be successful in developing countries, it would tend to improve people's living standards, and would generate revenues to develop other sectors such as manufacturing and would tend to modernise rural areas so that they catch up with urban areas.

However, the complexity of the nature of economic development provokes major controversy among scholars. For example, some scholars such as Mosher (1964) perceive the process of agricultural development simply as the productive activities of people cultivating land and tending livestock. Southworth (1968), on the other hand, believes that a fully developed theory of agricultural development should

take into consideration the interaction between agricultural and non-agricultural sectors.

In any case, agricultural development can be measured by the output per worker whereby the higher this output the more advanced and successful is the agricultural development in the country. For example in India, output is almost one-fifteenth that of the US, and yet very few of the developing countries show outputs as high as one-fifth of the US.

In developing countries, Libya being no exception, numerous obstacles hamper agricultural development. These obstacles may be economic, social or technical. Most important of these obstacles is the inadequate training of farmers and their failure to cope with modern technology due to widespread illiteracy.

Agricultural development, however, can receive a great boost in developing countries through the reclamation, reform and efficient allocation of land provided the above mentioned obstacles are tackled.

CHAPTER THREE

AGRICULTURE DEVELOPMENT STRATEGIES IN LIBYA

3.1. Introduction

Libya, a North African country, lies along the southern coast of the Mediterranean Sea, approximately between latitudes 18 and 30 North and longitude 9 and 25 East. Its total area is about 1,759,540 km^2 of which more than 90%are desert. Most agricultural activities are limited to a long narrow strip along the Mediterranean coast, the low mountains and scattered oases in the desert. The human population is about 5,678,484 inhabitants.

The prevailing climatic conditions are typical of the Mediterranean region characterized by variability and unpredictability. The rainfall is erratic in quantity, frequency and distribution. On the basis of climate and soil conditions, four agricultural regions are recognized (Mohammed, et, al 1996):

- Coastal belt: a narrow strip with a width varying between 5 and 25 km along the sea. However, south of this, in the west this plain extends to a distance of more than 100 km in the form of an arc forming what is known as the Jafara plain. The average rainfall there is 200-250 mm. supplementary irrigation, using underground water, is a common practice in this area. Future expansion of irrigation using underground water is very restricted due to the lowering of the water table (1 to 5 m/year) and seawater intrusion. The soil in the western part is sandy or sandy loam, very low in nitrogen and organic matter contents with neutral to slightly alkaline reaction, while soils in the eastern part are heavier, mainly sandy loam to clay loam.

- Low mountains: there are two distinct and geographically separate low mountain areas located immediately south of the coastal belt: one in the eastern part known as Jabal Al Akhdar, and the other in the western part known as Jabal Al Gharbi. These mountains are generally rocky and stony and intercepted frequently by many wadis (rivers). The average rainfall in Jabal Al Akhdar ranges between 250-600 mm; the soils are terra-rossa or heavy clay (Azzawam, 1984). In Jabal Al Gharbi the average rainfall is much less, ranging between 200 to 300 mm. The soils are much lighter and more variable than those of Jabal Al Akhdar.

- Semi-desert areas: which are located immediately south and parallel to the Jabal regions. The average rainfall varies from 50 to 150mm, and it is used mainly for grazing. However, some primitive agriculture is still practiced by the nomads in the wadi beds.

- Desert: consisting of sand dunes and gravelly barren, rolling hills on plains. Rainfall is almost non-existent. Agriculture is confined to a few scattered oases. However, due to the recent discovery of vast quantities of underground water in some parts of the desert area, some government sponsored agriculture projects have been established, aiming at reclaiming the land and settling the nomadic people. This has resulted in bringing about one-hundred thousand hectares under permanent irrigation.

The first section of this chapter discusses the role of agriculture in the current development strategy, the main characteristics of agricultural development and related problems.

The second section, however, discusses agricultural planning, the agricultural development plans 1973-1985, the importance and growth of the gross domestic product and monetary allocation and the actual development costs 1973-1985. This chapter concentrates on the policies of centralized planning and decentralized execution in relation to the agriculture sector during the period of 1973-1985 and attempts to determine the faults inherent in those three plans especially those concerning the relationship between planning and execution.

Moreover, we will discuss the estimates and forecasts which relate to developing agricultural production and the current needs of society, as well as the actual needs of the agriculture sector during the period 1986-2000,Co-operatve and marketing system. Then the monetary allocations to the various projects are discussed, comparing these to the actual expenditure in order to define the degree of completion of the development plans, the importance and growth of the gross domestic product and monetary allocations and the actual development costs 1973-1985 along with the problems and difficulties that faced the execution of the agricultural reform and land use.

This period witnessed the execution of three schemes, which produced significant changes in 1973–1975, 1976–1980, and 1981–1985. During this period, there were profound increases in investment in all economic sectors including the agricultural sector.

The increase in economic activity during this period was due to the availability of financial resources, and the huge reserves of foreign exchange. The availability of capital during this period rendered the economy less dependent on oil exports and led to more efforts being made towards the local manufacturing of oil products. Also, more attention was given to the agricultural sector, aiming at achieving self-sufficiency in agricultural products, hence gradually reducing the imports of these products.

3.2. The Role of Agriculture in the Current Development Strategy

Agriculture was predominant in the country's economy prior to the discovery of oil. The agriculture sector was one of the largest sectors to contribute to gross domestic product (GDP).

In addition it was the main export. According to the 1964 census, 54.8% of the total population of 1,6 million depended on agriculture for their livelihood (Mazzocchi, 1991).

With the discovery of oil, which became the economy's main support, and the related heavy investment to develop most sectors, the importance of agriculture

diminished in its contribution to the GDP. However, in addition to providing the essential living necessities such as food and raw materials for industry, agriculture still represented the main support for the inhabitants of the countryside who represent approximately 65% of the population (Eegaam, 1992). The complete understanding of the importance of agriculture in achieving the different main aims of development in Libya in the short and long terms, has been given high priority in Libyan planning programmes, where it has the following main roles to play (Al-Gendil, 1985):

A- It can render the economy less reliant on foreign influence, by providing the maximum levels of self-sufficiency in food, by increasing production of the main food materials in a way that preserves natural resources such as water and land, as well as guaranteeing their ideal utilisation.

B- It can minimise the disparity in income between the different population groups, by raising the low incomes of the farmers.

C- It encourages the efforts to provide balanced growth in the regions (countryside), by establishing new agricultural production projects and the habitation of regions that have not been used up to now, or that have been neglected in order to benefit from its production capabilities, especially where there is an abundance of water.

D-The continuity of the agriculture sector plays an important role in the economic diversity that will achieve self-sufficiency in the long run. It is also a source of

work opportunities allowing an ideal utilisation of the country's human and natural resources (Al-Gomati, 1999).

3.3. Characteristics of Agricultural Development and its Related Problems

1- Decrease in the importance of agriculture in its contribution to the gross domestic product (GDP).

2- Increase in Libyan's economic reliance on imports of numerous food products and workforces.

3- Increase in the importance of the role played by the public sector in areas of production, marketing, distribution, pricing policy; and the neglect of the role of the private sector, which in some cases harms the welfare of the agriculture sector.

4- Abuse of natural resources, especially arable land and layers that contain water in the Jaffara plain, which creates additional problems such as the destruction of the soil and the influence of seawater.

5- Widening irrigation services and the main infrastructure, to aid crop and animal production in areas that have so far remained neglected and backward.

6- Improving individual incomes from agricultural production without relying on non-agricultural income.

7- Incapacity of the agriculture sector regarding its organisation, infrastructure and management to accommodate such huge investments. However, this may result in great losses, and a failure to accommodate human power as well as an unjustified extension of production cycles, with the final outcome being huge development costs.

8- The huge size of the country, including material, population and climate disparities, where approximately 90% of the population are concentrated in the narrow northern coastal strip traditionally known as the major agricultural areas. This, of course leads to problems of the excessive use of natural resources or their depletion in the areas most suited to agriculture (Al-Gomati, 1999).

9- The improvements that have occurred in agricultural productivity are minimal, if they exist at all. Its standards were low compared to the current incentives offered to framers, the great investment and efforts, and the ambitious development policies conducted in Libya in the past ten years.

3.4. Agricultural Planning and the Agricultural Development Plans 1973-1985

The national economy is characterised by contradictory elements. There is huge a land area as opposed to a small agricultural area (5.4% of total area) on the one hand, and a small population of 4.5 million (Industrial Development Center of Arabic Countries 1986) on the other hand which means that population density is estimated at 196.5 inhabitant, per 100 acres (1 km^2).

Geographically the population distribution is also not well balanced. We find that 47.3% of the total population occupies the western region, with 25.6% in the eastern regions, 21.2% in the central regions, and 6% in the southern regions (Secretariat of Planning 1985). Further, the small percentage of the population that lives in the south is spread rather sparsely in an area where connecting them with means of transport proves expensive. This is in addition to the difficulty of

providing social services and the rise in the costs in providing such services. However, this area has the largest water reserves, in addition to large reserves of raw materials (iron). In order to exploit these natural resources economically, they must be transported to the north where the majority of the population lives and the most fertile lands lie, and yet the transport operations for this are also quite expensive. Even if there were arable lands in the south, the process of transporting produce to the consumption centres would be difficult due to the lack of efficient transport systems such as railways.

In addition to the natural resources, there are huge oil reserves that Libya has been exploiting since 1961 (Farhat, 1987). These oil reserves are the source of huge revenues that are used to fund social and economic development projects. Due to the huge levels of general expenditure and its evolution year after year from LD 1,298 million in 1974 to LD 3,922.8 million in 1981, and LD 2,511 million in 1985. The purchasing power of the population has also increased (Central Bank of Libya, 1995).

In addition to all these natural resources, the coastline, extends over more than two thousand kilometers, with a huge fisheries wealth if this could only be utilised in an ideal way. But the lack of population and unfortunate distribution of the workforce in terms of the services and production sectors or according to economic activities (Eegam, 1987) in addition to other economic, social and

political factors has made the possibility of benefiting from all these resources rather limited.

Economic planning is the method utilised by social communities to regulate the process of economic development in order to raise the standards of living by means of the best utilisation of the available resources. This also includes putting into action or drawing up a complete economic and social plan that sets definitive goals to meet the demands of the society, achieving these goals through various projects in all fields (Hashem, 1985). The planning must be complete, where economic and social goals are defined and decided and translated into executive policies and programmes in the context of a general plan to define and use the resources which also includes a financial and funding plan (Hashem, 1985). Due to all the above we can say that planning is the other face of the political and economic system. Hence there are three types of economic planning:-

- Centralised planning – where a central planning agency prepares the plan and depends on the authority of the government.
- Decentralised planning- where decisions belong to local political organizations (councils).
- The third type is a combination of the previous two, where planning is central (authority of making decisions concerning goals and defining resource and raising production), but detailed work decisions become the responsibility of local executive committees, but within the previously designed general policy. This is what is referred to as centralised planning and decentralised execution (Hashem,

1985). This third type is the type adopted in Libya's economic planning during the period 1973-1985, where planning was centralised (by the Secretariat of People's General Planning Committee), but the execution was the responsibility of the administration or committees directly related to these projects.

In the framework of centralised planning and decentralised execution, the financial allocations or the total availability of cash for the agriculture sector during the economic planning period 1973-1985 was LD 5,555.9million (Central Bank of Libya, 1995). The agriculture sector always received first or second share from the development budget, in addition to various tax exemptions and the continuous support policies offered to the agriculture sector. This is proof of the importance of the agriculture sector in the national economy on the one hand, and to the decision-making authorities on the other hand. Despite these huge financial allocations and other help, the prices of agricultural products have risen sharply, and have become unaffordable especially for low-income families.

From economic interpretation, the rise in prices of agricultural products can be attributed to the following reasons: -

- The size of agricultural production is tiny compared to the continuously increasing demand.
- The public has a strong purchasing power (cash flow) compared to what is actually on the market (product display).

- The hoarding of goods by consumers who mistrust the market, or the monopoly of goods by greedy middlemen (bad distribution), i.e. artificially reduction of quantities displayed.

The main and most important reason remains low supplies and high demand, or in other words low production and high consumption (Eegam, 1992).

The economic planner deals with all contradictory elements and takes into consideration local and international economic changes in addition to changeable economic indicators. Prices, and especially the prices of food (agricultural products), are one of the main economic indicators to the planner. Those prices have risen because there has been a decrease in the volume of agricultural production, despite the huge financial budget devoted to the agriculture sector.

3.4.1. Agricultural Planning Policies 1973-1985

The Revolution of the First September intended to correct all aspects of previous failure, to set right the balance of economic life, and to highlight the weak points that have characterised economic and social development during the1960s and to put into place a new development strategy based on the following: (Secretariat of Planning, 1976)

- Reducing the reliance of the national economy on oil
- The diversification of the national economy by introducing economic activities with high productivity that will achieve high levels of growth, such as in agriculture and industry.

- Raising the capability (standards) of the human element by teaching and training in various social and economic fields, in order to increase effectiveness and participation in building a new society
- Using all local potentials and strengths to achieve the highest growth
- Reducing social and economic differences among the population.

However, the Tri plan 1973-1975, the first transformation plan 1976-1980 and the second transformation plan 1981-1985 were all designed to achieve this strategy. This part of the study discussES each plan separately in terms of how far it went in achieving the desired goals. The study will also try to higlight the weak points and problems pertaining to these plans, and how they affected on the national economy in general and the agriculture sector in partcular.

3.4.1.1. Agricultural Planning in the Tri Plan 1973-1975

The main obstacles and weak points that constituted stumbling blocks in achieving the plan's goals can be summarised in the following points:-

- The method that was used in preparing the plan was not be counted only a list prepared by the various ministries for projects his career nation should win the national economy was not study to,as most projects did not have any economic studies.
- The plan lacked comperhensiveness as it did not contain any social planning.

One criticism levelld by the Tri Plan that the education system had not heeded the economic requirements of the country during the previous period 1963-1972

(Secretariat of Planning, 1976) can also be directed at the Tri Plan itself, since the numbers enrolling in technical education was very low (less than 1%) of total students in 1975 (Eegam, 1987). In addition the technical and professional skills of the population also remained low.

- The effort to develop the workforce in the agriculture sector was only an estimate of the required number, without classification of the technical and professional skills required. The discrepancy between the display of human as a quality and quantity and the out to have a requirements (Secretariat of Planning, 1986).

- The Tri plan did not create the required balance between general expenditure and levels of increase (Eegam, 1992) on the one hand, and the productivity`s energy of the national economy and the ratio of its increasing on the other hand (Eegam, 1992). The reason was that the absorption of power of the national economy was limited, especially that the supply of the producution was not elastic (Secretariat of Planning, 1986). Therefore it was anticipated that the national economy would suffer from inflation and a rise in cash flows. This inflation itself included the waste of oil wealth,using it for incendiaries by increasing the income of the population as a direct result of increased oil production (Secretariat of Financial, 1978).

- A great number of projects that were incorporated into the plan were not completed on time, and hence the contribution of these plans to the national economy remained very little or even negligible (Eegam, 1981). The reason for not executing these projects could be attributed to the rise in the prices of exported

investment products as a result of the rise in the price of oil impossed by OPEC in 1974.

- One of the main aims of the plan was to enable the government to implement a social, cultural and economic national system that took into consideration the full cooperation of the public and the private sectors so as to achieve the goals of economic development (Transformation Plan, 1976-1980). However, despite its well defined goal, the plan did not elaborate in any detail how this cooperation would take place. There were no directives in the plan for the private sector, and no concerete financial or economic policies to be followed (concerning granting loans and subsidies, subsidising prices, taxation), or what investment avenues were open to the private sector in the various agricultural fields (Tri Plan 1975). Yet, it is worth mentioning that the participation of the private secor in invesments planned in the Tri Plan was estimated at LD 25 million, and about 6.8% of the total of the investment in the private and public sectors went to the agriculture sector (Tri Plan, 1975).

- There was no link between planning and implementation. That the Tri Plan was devised according to various suggestions emanating from different ministries concerning a number of projects that each minstry thought was important during the plan's years. Annual allocations were based on what was suggested for these projects. As costs did not actually correspond to the size of annual financial allocations, it could be generally said that the ministries' suggestions with regard to the the various projects to be carried out were not made upon the correct basis. Moreover these projects were not studied according to executive capabilities, as

the departments executing them, in most cases, were those who suggested them rather than those who would benefit from them.

- Analysis of the execution of the plan highlighted problems and difficulties such as insufficient feasibility studies of the projects, lack of skilled workforce, crowded ports and other such obstacles (Transformation Plan, 1976-1980).

It is evident from all the above that theTri- Plan 1973-1975 failed to overcome the bottlenecks and weak points that characterised the national economy during the period 1964-1971, which the Tri Plan was created to overcome.In particular it failed to achieve balanced growth between the sectors and not benefiting from the increased demand for products and services and establishment of production projects to close the consumption gap.

3.4.1.2. Agricultural Planning in the Transformation Plan 1976-1980

This plan came at a time when international economic circumstances were favourable, especially in the wake of the rise in oil prices that resulted in huge revenues in 1974. Consequently general expenditure based on financial allocations increased from LD 1,496.2 milliom in 1975 to LD 1,751.2 million in 1976 and to LD 3,501.6 million in 1980 i.e an increase of 99.95% compared to 1976 (Central Bank of Libya, 1991).

This plan was put in place in order to continue the development process was started by the Tri plan. The Transformation Plan made great strides in achieving its

goals despite the fact that some of these goals were unrealistic, and that only a short period of was time allocated to execute the plan (Transformation Plan, 1976-1980). However, despite these huge financial that presents one of the main elements to financing the economic development process, the Transformation Plan 1976-1980 again faced numerous obstacles and problems that can be considered as weak points of the plan itself.

- The plan was characterised by wastefulness and over-expenditure of resources. Projects were started everywhere without economic feasibility or social outcome studies, and the main reason was due to the abundance of funds and a decrease in the marginal utility of the dinar.

- The capacity for assimilation of the national economy remained limited, even during those years, especially in the ports and other services .

- An imbalance between the availability of the local workforce and the need to fulfil the needs of the development plan remained, which resulted in an increase in the foreign workforce from 223,000 in 1975 (33% of total workforce) to 280,000 in 1980 (34.3% of total workforce) in the country (Second Transformation Plan, 1981-1985). Consequently the foreign workforce increased by 25.5% between 1975 and 1980. Students in primary schools represented 76.2% of total students for the period 1975-1980, and the number of students in technical education remained very low at about 1.8% of total students for the same period(Second Transformation Plan, 1981-1985).

- A number of businessmen moved to the agriculture sector, though not with the intention to assist production, but rather to invest funds in betting on land and

farms which led to huge increases in their price. Negative effects on agriculture sector appeared due to the change of traders and investment in land reform, well-drilling, and tree-planting especially in the coastal strip area where the horizontal expanded.These negative effets included :

1- The horizontal expansion in agriculture led to the drainage of ground water in the coastal strip area and a changes in the ground water balance which resulted in serious water problems where the total number of wells for each 100 acres was estimated at 86.9 wells. An increase in the planting of citrus trees where production reached 25.9%, whereas olive trees represented 22.6% and palm trees did not exceed 5.8% (Secretariat of Agriculture, 1980).

2- Agricultural farms were split and the total number of farms reached 200 thousand farms. It therefore became difficult to exploit them economically especially when 53% of these farms coverd less than one hectare, while 75% did not exceed three hectarss (Second Transformation Plan, 1981-1985). One of the disadvantages of this spliting was shortages in the specialised workforce in the field of farming, and the lowering of annual incomes. Yet, it became evident that any further split in the farmlands would lead to further decreases in the workforce and also to further drops in the average agricultural income.

3- The age of 47% of those employed in farming in the coastal strip ranged from 56 years and above. This had a direct effect on the agriculture sector.

To summarise all the above, the plan 1976-1980 did not adhere to any principle of comprehensiveness for all sectors, and did not study and therefore did not expect

the changes and variables during its execution. It did not take the private sector into cnsideration except in so far as it participated in permanent local investment, and it also did not study the special relationship between the public and private sector especially in the agricultural sector.

From this we can deduce that the planning did not have any participation in taking the political decisions. The plan was implemented without prior knowledge of political policies that would have direct effect on the economic lifestyls of the people.

3.4.1.3. Agricultural Planning in the Transformation Plan 1981-1985

The transformation plan 1981-1985 was put into action to transform in the agriculture sector in view of the past achievements and obstacles, taking into consideration the capabilities and importance of increasing production and the productivity of natural and actual resources available to the sector (Second Transformation Plan, 1981-1985).

Considering the exaggerated reliance at the on time the importation of food products and the rapid rise in demand, it became extremely important to achieve further growth and expansion in agricultural production, and to give this sector priority in all transformation plans (Second Transformation Plan, 1981-1985). The Transformation Plan 1981-1985 consisted of sixteen elements, of which the following are the most important :-

- Providing the necessary workforce for agriculture.
- Implementing basic changes in the marketing system so that it would have an impact on the transformation process from typical agricultural methods to agricultural production methods, and re-arranging and supporting agricultural co-operatives (Second Transformation Plan, 1981-1985).
- Altering and restudying pricing and funding policies so that these would become an active and effective tool in directing and increasing agricultural productivity and securing a reasonable income for farmers (Second Transformation Plan, 1981-1985).

This plan was implemented when income from oil was at its highest. The allocations to development reached LD 3,501.6 million in 1980 and LD 3,922.8 million in 1981. As soon as the first year of the plan was completed, leanes years started when income from oil and general expenditure in 1982 reached LD 2511 million, a reduction of 36% in comparison to 1981 (Central Bank of Libya, 1986). It is noticeable that the size of development expenditure on projects decreased faster than overall expenditure, going down from LD 2,872.7 million in 1981 to LD 1,311 million in 1985 (representing a decrease of 54.4 % from 1981).

Current expenditures increased from LD 1,050 million in 1981 to LD 1,520.40 million in 1983 and only decreased in 1984 and 1985 to reached LD 1,440.2 million and 1,200 million respectively for the last two years of the plan (Central Bank of Libya, 1985). From this we can conclude that investment expenditure

decreasd more quickly than did current expenditure (investment). That is because Libya as is the case with other oil producing countries was interested in consumption before investment and the increase of production. This contradicted of the general strategy referred to at the beginning of this section.. It is worth mentioning that the agriculture sector was the first sector to be affected whenever there was a drop in oil revenues. As a result of the drops in oil revenues, the shrinking volume of development expenditure and increases in current expenditures, the following political decisions were taken that had a great effect on the agriculture sector in general and agricultural production in particular :-

- Stopping the issuing of short-term loans in 1982. This type of agricultural loan is essential for financing seasonal agricultural projects (ploughing, grains, pesticides, etc.), especially to traditional farmers with low incomes.
- The cancellation of forage subsidies in 1982. This decision had a negative effect on animal production, especially after the fixing of the selling price of animal products (such as milk) by the Peoples Administration. The cancallation of subsides meant arise in production costs. If established or imposed prices are not in harmony with production costs, then farmers will abandon agriculture, as is currently happening in the southern regions.

- The directives to re-organise agricultural marketing in 1982 left tons of vegetables to perish in the farms, especially in the western areas. This was due to the inadequacy of organisation in the marketing departments and its inefficient routine operations.

- Then came laws or decisions regulating the importation of foreign workers, and evetually in 1985 a decree to abolish the employment of the foreign workers.

Since new farms using modern production generally utilised foreign workforces, farms were abondoned by their owners, which resulted in huge losses of the money spent on the agriculture sector since the start of the plan. From this we can conclude that a number of decrees and decisions were carried out without proper consultation. The same also applies to monetary policies and decrees. Furthermore the plan did not succeed in eliminating differences and imbalances in the education system and workforce, as the number of primary pupils remained high 62.9% but secondary technical students represented only 2.0% of total students in 1985 (Secretariat of Planning,1986) hence the reliance on foreign technical expertise up to 1985.

3.5. Agricultural Production in the Development Plans 1973 -1985

The general economic view and of course economic analysis in essence means economic planning, whereas economic analysis relies on organised human behaviour based on sound principles becoming in essence a specialised analysis (Secretariat of Planning, 1986).

The plan is a working programme for looking into future to achieve defined goals. This remark shows the truth of economic planning and its scope of influence. It also shows that planning is usually based on analysis and the study and the

understanding of actualities. Therefore, it is important to define the goals of planning as part of its relative acceptability (Second Transformation Plan, 1981-1985).

However, planning relies on the near actuality or the distant past, and despite the difference in time, future expectations must not be planned haphazardly but must rely on a chain of timely events and the placing of alternative plans based on more realistic forecasts.

The aim of all national development plans 1972-1985 was to increase the gross national product and at the same time to diversify the economy and thereby to free the economy from its heavy dependence on its leading sector oil and gas production. The dominant objectives of all these economic development plans was been to reach self sufficiency in food production and other basic commodities, to reduce regional inequalities in income and to develop human resources through education and training (General Committee for Agriculture and Reclamation, 1983).

3.5.1. The Development of Agricultural Production (Aspirations and Aeality)

Some special details relating to the actual production of some agricultural products (plants and animals), and the estimates (expectations) of agricultural production referred to in the Tri Development Plans 1973-1985 (see Appendix B, tables3.3,and 3.4).

The following facts can be drawn from these tables :-

- The actual average production of wheat and barley in 1969-1970 reached 49.8 thousand tons and 88.4 thousand tons respectively, whereas in 1972 the production of wheat declined to 41.6 thousand tons, and barley increased to 116.4 thousand tons. The Tri plan 1973-1975. The estimated wheat production at the beginning of the first years of the plan 1972-1973 was around 80 thousand tons i.e about double actual production in 1972, and the production estimate for the first year of the plan was estimated at 90 thousand tons, rising to 120 thousand tons in the second year and reaching 200 thousand tons in the last year of the plan 1975.

When we compare these estimates the actual production in 1972, which was 380.7% during three years only, these expectations were far removed from reality. When we compare the estimated production for the year 1975 of 200 thousand tons with the actual production for the same year, which was only 75 thousand tons, we discover that the forecasts exeeded reality by 166.6 %. In other words actual production represented only 20% of the forecasts. We also realise that the estimates for the development plan 1976-1980 fell well below expectations.

The actual production in 1976 was 130 thousand tons, and it was estimated that this would rise to 366 thousand tons in 1980 (158.5% percentage of increase in the years of the plan), whereas the actual production was estimated at 140.5 thousand tons. This means that the production achieved was less than half of the target production figure.

The estimate for wheat production in the second Transformation Plan 1981-1985 was 428.8 thousand tons. This exceeded the target production for 1980 by 27.6%, and exceeded the actual production for the same year 1980 by 205.2%. This suggests that the aims of the plan were execessively ambitious and far from being realistic.

- As for barley production in the Tri Plan 1973-1975, the production level increased from 88.4 thousand tons in 1969-1970 to 116.4 thousand tons in 1972 (an increase of 31.7%). However, the primary or initial estimates for 1971-1973 were 135 thousand tons increasing to 150 thousand tons and finally 200 thousand tons, but the actual production for 1975 did not exceed 192 thousand tons, representing 96% of target production for the same year. Even when calculating the target as 216 thousand tons, the difference between estimated and the real production did not exceed 9%. As for the trnansformation plan, the actual production of barley for 1976, was 196 thousand tons, and it was anticipated to reach 245 thousand tons in 1980, i.e an increase of 25%, whereas actual production for 1980 was 71.5 thousand tons or less than the production in 1976 by 63.7 % and less than 1980 by 70.8%. However, it is interesting that in the second transformation plan 1981-1985 the production of barley was estimated for 1985 at 105.7 thousand tons, and this quantity was more than realistic and may have been less than the available production capabilities for this crop.

- As for vegetables, the aim of the Tri Plan 1973-1975 was to increase production from 382.3 thousand tons to 620 thousand tons in 1975 (an increase of 62.2%).

However, the actual production was 564 thousand tons, i.e about 90% of the target production figure.

In the first Transformation Plan 1976-1980 the target production for 1976 was 670 thousand tons increasing to 825 thousand tons in 1980, and yet actual production in 1976 was 544 thousand tons (19% less than that aimed for), and in 1980 actual production was 658.4 thousand tons, (79.8% of the target for that year).

When camparing the actual production for the years 1976 and 1980, it is evident that production did actually increase during the years of the plan, but at a rate of only 21%.

In the second Transformation Plan 1981-1985 the target figure for vegetable production in 1985 was 779 thousand tons, which was 6 % less than the target in the year 1980, and this difference, even though it is small, might signal a more realistic approach in the second transformation plan.

- The target quantity of forage at the end of the Tri Plan 1975 was 616 thousand tons, but actual production for the same year was 351 thousand tons, about 54% of the target total. Also during the first Transformation Plan 1976-1980 the target production in 1976 was 899 thousand tons increasing to 1321 thousand tons in 1980. However, the actual production in 1976 was only 391 thousand tons (44% of target production). In 1980, on the other hand, the estimated production was 390 thousand tons or 29.5% of the target production figure for the same year.

From this it is evident that forage production did not increase at all during the period of the plan 1976-1980. Despite these actual figures, the second Transformation Plan 1981-1985 site high estimates for the production of forage at about 657 thousand tons which represented half of the estimate for 1980 but 68% higher than actual production for the same year.

- As for dairy products, production increased from 51.1 thousand tons for the period 1969-1970, and reached 87 thousand tons in 1975 due to the support and subsidies of the Tri plan (an increase of 70%). The dairy production remained reasonable even during the period 1976-1980. In 1980 however, the estimated dairy production was 110 thousand tons, whwereas the target for the same year was 99 thousand tons (an increase of 11.1%) Yet, the second Transformation Plan 1981-1985 set high estimates amounting to 308 thousand tons of dairy products for 1985, which is almost 180% of the estimate production for 1980. The targets for 1985 were very ambitions, and yet they were difficult to achieve, especially given the cancellation of forage subsidies and the abolition of the employment of foreign workers.

- The production of meat increased from 42.3 thousand tons in 1970 to 44 thousand tons in 1975. However, during the plan years 1976 - 1980, it increased to 58.6 thousand tons in 1980 (increasing by 33%). This quantity of production represented 60% of the target for the same year, which was 98 thousand tons. Despite the fact that the first Transformation Plan 1976 –1980 stopped short of hitting its target, the second Transformation Plan 1981-1985 achieved more than

originally expected, as production reached 130.4 thousand tons which was 33% higher than than the target production for 1980.

- The production of eggs in 1970 was 2.4 thousand tons, and due to support and subsidy policies it reached 10.3 thousand tons in 1975. Even during the plan period 1976-1980 the target was within reason (11-14 thousand tons). Nevertheless the second Transformation Plan 198 -1985 set a target three times higher than actual production in 1980.

From the abve figures we may realise that the development plans regularly set ambitious and unrealistic estimates, especially for products such as wheat, forage, dairy, meats, eggs and vegetables.

3.5.2. Comparing Agricultural Production with Needs

Having discussed the development targets and the actual quantities of agricultural production, we need to discover the actual amounts of production that would be likely to achieve self-sufficiency in the most most important agricultural crops such as wheat and barley. Here, the following facts are highlighted(see Appendix B, table,3.5):

- According to the Tri Plan 1973-1975 wheat production covered 28% of the potential needs in 1973, increasing towards self-sufficiency at the end of the plan to reach 57.1% of total consumption in 1975. However, comparing actual production with actual needs in 1975, it is clear that the expected production

would cover only 21.4% and 76.8% of needs for wheat and barely respectively. This explains the soaring prices of these products as well as the need for importing them to cover the deficit. The plan 1976-1980 aimed for high levels of self-sufficiency estimated at 41.5% and 73.9% for wheat during the period 1976-1980, but for barley the local production will cover the needs and increasing to 560 % and 700 % during the years 1976 and 1980 respectively.

Comparing these figures with actual production in the years 1976 and 1980, it is evident that the rates of self-sufficiency were estimated at 21.4% and 43.6% for 1976 and 1980 respectively.

- It is worth noting that the needs for barley decreased from 250 thousand tons in 1975 to only 40 thousand tons in 1976 and 30 thousand tons in 1980, and in 1985 these needs were estimated at around 105.6 thousand tons. If we compare these figures with actual production, we find that the rates of self-sufficiency were 490% in 1976 and 204% in 1980.
- As for the second Transformation Plan 1981-1985, the needs for wheat were estimated at 570 thousand tons, whereas production was estimated at 428.8 thousand tons (a ratio of self-sufficiency estimated at 75.3%), whereas barley production will cover the needs of 50 thousand tons (Second Transformation Plan 1981-1985)

3.6. The Agriculture Sector During the Period 1986-2000

During this period, there was a huge drop in oil revenues, which was due to multiple causes such as the decreases in demand, the deterioration in international oil prices and efforts made by importing countries in rationing oil supplies to cope with these adverse economic conditions. The decrease in oil revenues was reflected in huge deficits in the national budget for the first time, and its failure in funding the investment and development schemes. As a result there was a noticeable decrease in funding for the agricultural sector. This can be explained by the lack of intention to expand this sector, which implies putting more resources into increasing production. Instead, it was felt more appropriate, at this stage, to limit efforts to achieving the maximum utilization of the already existing resources.

3.7. The Role of Co-Operatives

Even though co-operative societies are legally constituted, and membership is obligatory for settlers, they are a form of organization that is quite new in Libya, with neither farmers nor government administrators having any experience of co-operative activity. Obviously, there were going to be difficulties in the setting up of working agricultural co-operatives. The lack of training and weaknesses in administrative and executive co-ordination of co-operative policy caused considerable delays in policy implementation.

However, the government saw the development of co-operatives as integral to rural progress and a means by which the agricultural methods employed by smallholders and settlers could be revolutionised. As noted above, all beneficiaries of land settlement are required to belong to co-operatives, and the government intended to extend compulsory co-operative membership to all landowners holding less than 8 hectares of land.

Agricultural co-operatives were subsidised by the state, providing equipment, spare parts and fertilizer at fixed prices, as well as marketing facilities, to farmers.

Afurther function of the co-operatives was to foster the ideology necessary to establish co-operative farming units.

In reality, however, the co-operatives are still a long way from achieving their objectives, and have become no more than state shops, without any sense of participation on the part of the farmers.

3.8. The Marketing System

After 1976, marketing became a state monopoly. Imports became controlled, and the government took responsibility for the distribution of a wide range of agricultural and other goods. This involvement in marketing by the government was justified using the argument that the private sector was inefficient and was monopolized by a small number of traders. Also significant was the view that in the private market, the middleman exploits both farmers and consumers. State involvement in marketing would, it was argued, end this exploitation.

However, experience has shown that public sector marketing agencies may not be more efficient than the private sector. Often, the aims set for these agencies are both unrealistic and inconsistent. They are expected to provide cheap food, but at the same time they are expected both to create employment and to generate government revenue. Key staff may be appointed for political reasons, and even where the top managers are competent, they may be pressured into expanding their staff for political reasons. In the absence of flexibility in staffing, competence and morale often deteriorate. Financial problems are common, as funds may be inadequate or released at the wrong time.

Public marketing agencies have found it hard to cope with the complexity of the market, especially in areas dominated by smallholders. Here, the agencies have to buy small quantities of food from thousands of farmers widely dispersed in places

where transport is costly and difficult. Public agencies also find it difficult to adopt the differential pricing policies which are needed to promote efficient trade.

While intended to prevent exploitation of the farmer and consumer by the middleman, the agencies themselves are open to corruption. Recognising the problems of the public marketing agencies, in recent years the government has permitted a limited private marketing system, allowing each farmer to market his production freely. Although it was intended that farmers should directly market their production without recourse to middlemen, this has not been practicable, and so the door has thus been opened for the middlemen to return.

3.9. Importance and Growth of the Gross Domestic Product

Libya has a total area of around 1.76 million sq. km, of which 97.5% is desert. Statistical Records for 1995 show that arable land amounted to 2.06 million hectare with a 4.4% decrease compared to 1997 (National Authority for Information and Documentation, 1999).

The population of Libya in the year 2000 was estimated at 5.7 million with an annual growth of 3.5% during the last quarter of the 20th century. However, the fast growth in population has led to an increasing demand for agricultural products. This increase in demand has its implications for the processes of economic development in general and for agricultural development in particular, aiming at improving the standard of living for the population. Yet in the 1970s

agricultural activity within the Libyan economy could be described as primitive and awkward. Before the 1970s, 70% of the population was engaged in the agricultural sector, and yet the contribution of this sector to the national income did not exceed 26%. However, this could be due to low productivity as a result of various reasons, such as a lack of capital and modern technology, inadequate water sources, changing climatic conditions or even the prevailing seasonal inactivity of the population. Moreover, the discovery of oil and its consequent export had further negative effects on the contribution of the agricultural sector to the gross domestic product (GDP). The contribution of the agricultural sector had plummeted from 5.4% in 1965 to 2.6, 2.3, and 2.1 in the years 1970,1975, and 1980 respectively. However, its contribution increased to 9.4% in 1995 and then to 9.9 % in the year 2000 (see Appendix B, Table, 3.6). This increase could be attributed to the ever-increasing attention paid to the agricultural sector in the wake of the 1970s, and the absolute determination to achieve self-reliance in producing food, and ultimately to achieve self-sufficiency. Increasing the amount of irrigated land, which had already increased by 7% in the 1970s, could do this. However, despite the further increase in this land to 26% in 1995, most of this increase was rainwater dependent. Hence, in these circumstances, non-cultivated land amounted to around 81% of all arable land, which resulted in inconsistencies in agricultural production due to changes in the amounts and timing of rain.

This put more pressure on the process of agricultural development, and made the employment of modern technology an urgent matter in order to deal with such situations, especially in the field of irrigation.

However, boosting agricultural production both horizontally and vertically, as well as achieving the best use of economic resources, became a target for plans for economic and social change. Hence, the development plan was directed towards achieving the following objectives:

1- Horizontal expansion of cultivated land in the form of agricultural schemes. The state usually undertakes the task of managing, supervising and marketing the products of these schemes. These schemes are characterised by their huge size and their mixed farming activities.
2- Vertical expansion in agricultural production. This is achieved by encouraging the use of modern technology for increasing land use and animal productivity provided that the use of water is kept to a minimum.
3- Preservation of natural resources and the environment for the sake of future generations.

The adoption of the above mentioned policies should eventually lead to achieving an annual growth rate of 10.8% in egg production, 7.5% in meat and 5.5% in milk. Also this would be reflected in an increase of self-sufficiency in other agricultural products such as vegetables 100%, meat 85% and fruits 80% (Elhasia et al, 1984).

However, despite the developments that took place in the agricultural sector, the contribution of this sector to gross domestic product (GDP) during the period 1970–1997 remained very weak. During this period the real annual growth rate of the gross domestic product was 1.08, which was not consistent with population growth. Therefore it is obvious that the growth rate in agricultural production did not cope with the increase in demand that came as a direct result of social and economic development. This had a negative impact on the contribution of agricultural production to the Libyan economy.

Also there were shortages in the production of grain and animal feed, and this negatively affected the individual share of grain products, which was equivalent to 106 kg per year during the period 1973–1979. This dropped to 42 kg in the year 2000 with 70% decrease (Secretariat of Panning, 1998), which also negatively affected the hope for self-sufficiency.

Despite the huge efforts towards agricultural development after the 1970s, the country still imports considerable quantities of food materials. It is obvious that development and growth in the agricultural sector has not been sufficient to cope with the growth in population and improvement in living standards. Moreover, the policies for agricultural development have not, so far, made the farmer completely dependent on farming as a sustaining source of income to match other sectors in offering him and his family a secure living. Also, the role of the agricultural sector

in securing food and clothing for the population is becoming more complex as the urban population is continuously on the increase.

The inadequacy in the growth of the agricultural sector can be attribute to the following reasons:

A) The decrease in productivity per unit hectare despite the introduction of modern technology after the1970s. Yet, the insufficiency in the development of production has affected the development of the gross domestic product. However, despite the use of modern technology in the expansion of the cultivated land, and the application of new scientific agricultural techniques, the contribution of the agricultural sector remained comparatively very low, which was due to the low growth rates in this sector.

Some of the reasons behind the low productivity of the agricultural sector are outlined below:

1- The failure of technology used to cope with the prevailing natural and environmental conditions.

2- The landowners were not fully engaged in farming.

3- The failure of the agricultural extension authorities to offer advice, and the lack of cooperation between farmers and the scientific research authorities.

4- The pricing policies were neither stable nor helpful to farmers, especially in the 1980s when farmers were forced to hand over their products to state-owned marketing organisations. Those policies had negative effects on the development of the gross domestic product.

B- The natural limitations for agricultural production include the following:

1- The limited agricultural land and the infertility of some of the areas.

2- The inadequacy and fluctuation of rainwater between the seasons of the year.

3- The inadequacy of ground water.

3.10. Monetary aAllocations and Actual Development Costs 1973 - 1985

The success or failure of the development plans is measured in terms of the plan's goals, and the final outcome compared to those goals. Whenever the actual costs are close to the general direction of the estimates, this reflects and is an indication of the success of the planner in the estimates of the National Economy, and therefore in designing and putting the plans into practice. The relationship between planning and execution may be strong or weak, depending on the ratio of actual to estimated expenditure. Therefore this section discusses the monetary allocations compared with the actual expenditure during the three development plans 1973-1985, in order to assess the levels of execution of what was planned for agrarian projects.

The monetary allocation for the agrarian sector and its eform in the Tri Plan 1973-1975 was estimated at LD 416.034 million (Secretariat of Planning, 1980). One of the main achievements of the First of September Revolution was the budget allocation for the agrarian sector (agriculture, reform, land reclamation, dam, water resources, fisheries), which during 1973-1975 reached LD 599.5 million, of which LD 558.7 million was actually spent i.e. the percentage of execution reached

93.2% (Secretariat of Planning, 1980). As for the Transformation Plan 1976-1980 the allocation for the agrarian sector was estimated at LD 1030.1 million (Transformation Plan, 1976-1980), whereas, once again, the allocations for the development plan 1976-1980 relating to agrarian sector (food and fisheries) was LD 1,856.4 million, and the actual total spent was LD 1,634.1 million, i.e the percentage of the implementation of the agrarian reform and land reclamation plan was 88.3%,and was 77.2% for food and fisheries (Second Transformation Plan, 1981-1985).

As for the second transformation plan 1981-1985, the monetary allocation was LD 3,100 million, and while figures for the actual spending during this period could not be obtained, we can say that there was decrease in expenditure from LD 2,872.8 million in 1981 to LD 2,365.9 million in 1982, and this decrease continued reaching LD 1,311 million in the last year of the plan 1985. This of course entailed stopping the implementation and completion of a number of planned development projects (Central Bank of Libya, 1981), Add to this the fact that the increase in their level of actual expenditure to the total monetary allocations does not necessary mean a high level of projects being actually completed. It could mean that the allocations partly covered the cost of the price increasing of investment products, especially after the inflation seen in 1974.

It is worth mentioning here that we cannot cosider what was actually spent on projects in the plan as an indication of what was completed. Spending a high

percentage of the monetary allocation does not mean that projects were completed. but is still not completely completed.

3.11. Problems Facing the Execution of Agricultural Reform and Land Use

A number of problems appeared during the execution of the schemes and transformation plans pertinent to the agricultural reform sector and land use. These problems can be summarised in the following points:

1- The slowdown of the companies and contractors involved, who failed to commit themselves to the agreed schedule.
2- Fluctuations and irregularities in rainwater.
3- Lack of workforce, especially technically trained personnel.
4- Lack of forage supplied at the required specifications, and at the right time.
5- The lack of appropriate marketing policies based on the correct scientific assumptions.

From the foregoing, it could be said that the indicators of policies in terms of government expenditure on investment varied according to the contribution of oil revenues to the general budget. However, in the event of the revival of oil revenues, the government had adopted constructive investment policies related to the execution of development plans, such as during the period 1973–1985. Yet, in the aftermath of the drop in oil revenues, the government has adopted less ambitious investment policies, which mainly aimed for the rationalisation of public expenditure and the concentration on the supply of basic consumer needs. Hence, during the period 1986-1995, the government neglected its commitments to long-

term development plans, and instead opted for short-term annual investment programmes.

3.12. Conclusion

Given the fact that most of Libya is an absolutely barren desert, agricultural activities are confined to a narrow strip along the Mediterranean Coast, where variable and unpredictable climatic conditions prevail.

In the aftermath of the oil discovery; in the early 1950s agriculture became less important with regard to its contribution to the GDP, and yet 65 % of the population, representing most inhabitants of rural areas, depended on agriculture as a source of income.

However, agricultural development in Libya has suffered many setbacks, the least of which is its failure to cope with the demands of the rapidly growing population. Nonetheless, despite the growing population, one of the main problems that has hampered agricultural productivity has been shortages in the skilled workforce.

Agricultural development has always been the top priority of economic planning, and policy makers and planners have tried to provide the agricultural sector with all of the necessary facilities and services that would be likely be help to improve its performance and augment its contribution to the national economy. Yet due to

the high purchasing power of the public, this sector has failed to meet the increasing demand for its products.

Following the September Revolution in 1969, planners and policy makers have realised the importance of agriculture to the national economy. Hence, the core of their socio-economic policies has been to render the economy less oil-dependent by diversifying economic resources. Therefore, to reach that end the agricultural sector has received more attention in order to achieve self-sufficiency, and to reduce the import of agricultural products. Consequently, agriculture has featured as the backbone of all the economic transformation plans spanning the period 1973-1985. However, following the 1986 drop in international oil prices the funding of the agricultural sector has deteriorated.

In order to revolutionise agricultural activities, the government has tended to establish agricultural co-operatives. Nonetheless, despite the huge subsidies provided to these co-operatives, they failed to achieve their goals. This failure could be attributed to many factors: in particular, the lack of skilled labour and the poor coordination of government policies. Yet, despite their failure these cooperatives are still considered by the government as being vital for rural development.

However, despite all the problems facing agricultural development in Libya, continuous efforts are being made by the government to achieve success. For

example, as the result of these efforts and the increasing attention given to agriculture, the contribution of the agricultural sector to the GDP has increased from only 2.1% in 1980 to 9.9% in 2000, with the maximum allocations for agricultural development standing at LD 1, 8564 billion in the development plans of the1976-1980 period.

CHAPTER FOUR

WADI AL-HAI AGRICULTURAL SETTLEMENT PROJECT

4.1. Introduction

Immigration from rural to urban areas, especially in under-developed countries, is the main stumbling block to development efforts in these countries. This movement of the population from rural to urban areas tends to put the cities under huge pressure to provide the necessary services to the rapidly increasing population, let alone the other problems it creates such as unemployment and environmental problems. In Libya, for example, following the oil boom the cities started to inflate as a result of the continuous immigration from rural areas. However, in order to reverse this situation and make the rural areas look more attractive, the Revolution of the First of September immediately considered rural development. Policymakers and planners realised that agriculture is the basic element to achieve rural development. In this regard the Wadi-Alhai project is one of the vital schemes associated with the settlement of the rural population.

Although this project has its own problems and setbacks, its very existence is a clear indicator that planners and policy makers are following the right steps towards achieving comprehensive and balanced development.

This chapter discusses the geographic location of the case study of the Wadi Al-Hai agricultural settlement project. This includes topography of the plain and highlands in the project, the general climate temperature, wind, humidity and rain the kind of soil and its productivity, water sources for irrigation, the main resources of water in the project, methods of irrigation, water situation in the project and housing conditions and social services in the project.

4.2. Geographic Location:

This project is located in the southern part of the Al-Jafara plain, 85 km from Tripoli on the road joining Azizya town to Bir Al-Ghanam. The project is 7.5 km across with Bir Al-Ghanam 10 km from its southern boarder, whereas Wadi Al-Athel lies in the south-west, behind the mountains, and drains its waters to the west of Bir-Al-Ghanam region. However, the region where Abu Shaiba agricultural project is located borders the project from the east.

The project extends between latitudes 32 15 and 32 24 N and longitudes 12 40 and 12 50 E, whereas the valley extends to the south down to latitude 32 5 where Jandubah region is located.

The Al-Jafara plain is estimated to cover 35,412 hectares which 12,000 hectares at the eastern part of the plain have been allocated for the establishment of agricultural farm settlements, with the to be rest used for grain production and as grassland. This agricultural area remains under the control of the Secretariat of Agricultural Reform and Land Use of Al Jafara Council (Shaabia).

4.3. Topography

Wadi Al-Hai agricultural settlement project is located on a plain area, which constitutes part of the southern Jafara plain. The relief of the area gradually increases towards the foot of the mountain. This gradual relief results in an overall slope to the north, as can be seen from the general surface view of the plane. Wadi Al-Hai area is divided into two main geographic divisions: the plain Wadi Al-Hai; and the highlands from where the rainwater flows.

4.3.1. The Plain

The plain of Wadi AL-Hai includes all the relatively level lands which lie to the south and southeast of the road joining Al-Azizya and Bir-Al-Gahnam. The plain encompasses an area of around 35,000 hectares, of which 12,000 hectares is allocated for the establishment of a number of artificially irrigated farms.

A number of hummocks used to cover the area, before it was made level. Those hummocks are of the type which make good ground for the growth of natural plants. However, most of these plants are still found in the area surrounding the project. Moreover many sand dunes used to exist in the area.

However, most of the soil has been removed from many sites on the plain by weathering, particularly by winds. This weathering of the soil has rendered huge areas lacking suitable plant cover. Hence the northwestern part of the plain is mainly covered with temporary and permanent sand dunes. On the other hand, the sandy nature of the soil in the southeast and western parts of the project is a clear indication that sand dunes have existed at some point.

The plain also used to be flooded by water pouring from the mountains. These floods used to accumulate in the plain in form of small lakes or swamps for a short period of time before they leaked into the sandy soil or evaporated into the atmosphere. Yet, in the north western part a number of permanent sand dunes still exist, producing an undulating surface, but which are nevertheless in most cases are covered with natural vegetation.

4.3.2. The Highlands

These highlands lie to the south of the plain. They can be divided into two parts: the first is in the form of a huge valley crossed by most of the valleys and floods heading towards the plain. However, due to active wind weathering most parts of this area have become barren desert. The other part extends from the middle of the mountains, and constitutes mountainsides with its steep slopes.

The valley area is bordered by Wadi Abu Shaiba from the east, and the Janduba highlands from the south, whereas to the south west lies the town of Kekkla. Wadi Al–Athel lies to the west, which drains its water to the west of Bir Al–Ghanam village.

A number of valleys originate in this area which end in the plain. Given the vastness of the Jafara plain, these valleys stop short of the sea.

However, the most important natural phenomenon in this area is that every wadi has its own drainage area before it reaches the plain. These drainage areas are:

- Wadi Zart

This is one of the biggest wadis that carrying water to the plain where the project is located. This wadi used to produce huge floods in the plain which would tend to wash out the soil and therefore would disrupt agricultural activities. This is the longest wadi in the basin. The upper and middle courses of this wadi are known as wadi Zarat, whereas its lower course is known as wadi Al-Hai i.e. after the region where its water drains.

- Wadi Khalfa

This is one of the biggest branches that flows from the eastern end to join the main course of wadi Zart from the Awlad Musa area to the north west of Al-Asabaa. However, most of the small branches flow into one course that crosses Awlad Al-Haj region to join the main course of wadi Zart. Most of the branches meet at Tafrit area, where wadi Zart dam is located, to make one course.

- Wadi Slulu

This lies at the northeastern end of the basin, and is the only wadi that flows northwards. It carries its water to the south of the second stage of the project. The water originates in the Eastern Rabta region and from the north of the Asabaa region. From the side that overlooks Rabta region a number of tributaries flows into this wadi. Also, one of its main tributaries is known as wadi Al-Zagoud,which flows from the mountains to the north of Eastern Rabta.

- Wadi Al-Gahriania

Some wadis flow from the west of Al-Gahriana into the plain. These include:

A- Wadi Al-Kinshata: this flows to the wst of wadi Al-Gahriana into the Maha area to the south west of the project.

B- Wadi Al-Waligi: this flows from Turab Um Suaig.

C- Wadi Al-Majti: this flows from the Zirar Al-Usha region.

D- Wadi Ein Shagara: this also flows from the Zirar Al-Usha region.

4.4. Climate

Climate represents one of the natural factors that determines agricultural activities. Climate directly affects the formation of crops as well as production processes. The prevailing climate in the area is poor (i.e. semi desert). This poor climate covers large parts of the southern region of the Jafara plain. However, the climate of the area is greatly affected by the Mediterranean to the north of the country, and due to the lack of natural barriers the Mediterranean influence is direct. Yet, barriers such as mountains disrupt the rains and humidity, whereby wind tends to moderate the temperatures of the region. This, to a greater extent, tends to reduce the effects of the semi desert climate that is the main cause of the higher temperatures.

The climate in Jafara region is generally moderate, warm in the winter and hot and dry in the summer.

The main elements of climate which affect agricultural activities in the area include temperature, humidity and rain

4.4.1. Temperature

The great and direct effects of temperature on crops are obvious. Hence, both high and low temperatures have adverse effects on plants. The study area lies between two areas of relatively extreme temperatures. In the summer the temperatures range between 32 to 36.8 degrees C at the two mountain areas. However, in July the temperature in the study area ranges between 32.6 to 38.5 degrees C. On the other hand the temperatures in the winter do not drop to sub-

zero, but range between 5.5 to 6.5 degrees C at the minimum, and 12.1 to 17.8 degrees C at the maximum.

However, spring is the most important season for agriculture, as the fruit plants start to blossom where the maximum temperatures range between 11.1 and 28.8 degrees C. Yet, despite the moderate temperatures in the spring, the temperature reaches its highest and lowest extremes in the summer and the winter respectively. These extreme temperatures do not continue for long periods of time, and they tend to be moderated by the hot and the cold winds from the south and the north respectively.

The highest temperatures, which sometimes range between 39.3 to 47.4 degrees C in the summer, on the other hand, will tend to reverse the direction of the winds to the north across the mountain towards the plain.

This is likely to cause a temperature rise in the northern parts of the plain. However, in the winter the temperature is likely to drop to between 1.6 and 2.7 degrees C in the region, and these temperatures are likely to continue for long periods of time.

The high temperatures may affect the soil, rendering it dry through losing humidity and resulting in the fading of plants.

On the other hand, the minimum temperatures are not so common in the area, but when they exist they usually do not continue for long, a fact that is

climatically favourable for agriculture. This makes the temperatures suitable for growing crops, vegetables and fruits.

4.4.2. Humidity

As humidity increases in the atmosphere, the temperature will drop, and yet humidity greatly influences the processes of plant growth, and therefore agriculture as a whole. Relative humidity can be defined as the amount of water vapour in the atmosphere. Hence, apart from other natural processes such as evaporation from seas and lakes, plants contribute to humidity through transpiration.

However, it follows that as humidity decreases in the atmosphere, plant transpiration and evaporation from the soil become more active. This will eventually increase the need of plants for more water to compensate for the loss of water by transpiration and evaporation from the soil. Yet, temperature and winds are the most important factors that affect humidity. Hence, the decrease of humidity in the atmosphere will lead to the fall of leaves and flowers to reduce transpiration, which will eventually hamper the process of plant growth.

The meteorological data available shows that the relative humidity in the study`s region is not less than 50% during the summer and will not exceed 69% during the winter. This indicates that humidity in this area is suitable for crop production. However, extremes of humidity of around 40% are uncommon in the summer, especially in the presence of the active desert winds. Nevertheless

highest humidity is usually associated with the cold winter winds, which carry the clouds and water vapour.

Moreover, humidity increases as the northwesterly winds become active during the rainy winter, and decreases as the dry southern southeasterly summer winds become active, and yet the northeasterly winds tend to prevent humidity from dropping to reach the minimum.

4.4.3. Rain

Rain represents one of the most important climatic elements. The significance of rains lies with the fact that it represents the backbone of all agricultural activity. Furthermore, rains are the source of all living activities as they are the source for fresh water found, in lakes, springs, and rivers as well as ground water.

In Libya, it generally rains in the winter during the period between October and April. However, climatic studies of the case study region indicate that rains in this region are triggered by whirlwinds that build up in low-pressure areas. In most cases, however, these are winter rains associated with thunderstorms. These rains usually originate in the west and then move in an easterly direction, which is the same direction of the Atlantic winds.

However, the rains in the Jafara plain are inconsistent with regards to amount, density and distribution. The study region (Wadi Al-Hai) receives rainwater

from the neighbouring mountainous area that allows the flow of rainwater into the region.

Rains has direct effects on all plants, especially rain crops and natural vegetation, which mainly depend on rainwater for the germination of seeds and other stages of plant growth. Table 4.1 indicates total precipitation during the three seasons in the surrounding area of the project, whereby in the winter the precipitation may exceed 5% of the total precipitation in the region surrounding Wadi Al-Hai.

Table 4.1: Distribution of Rainfall During the Year 2000

Item	Season				Total
	Autumn	Winter	Spring	Summer	
Al Nasseria station (1)	30.9%	52%	17.1%	0%	100%
Al Azizya Station	25.5%	55.5%	18.9%	0.4%	100%
Bir-El-Gahnam Station	23.9%	52.4%	22.7%	1%	100%
Gerian Station	23.6%	49.4%	27%	0%	100%
Al Asabha Station	25.6%	46.7%	27.7%	0%	100%
Kekela Station	28.6%	40.1%	30.5%	0.8%	100%
Yefran Station	23.2%	50.8%	25.5%	0.5%	100%
Optimum Rainfall	30%	20%	5o%	0%	100%

Source -Secretariat of Transportation, Tripoli, Libya, 2001.

From the above table it is obvious that precipitation in the autumn should be 30% in order to assist germination, but nevertheless according to the surrounding meteorological stations it is only 20%, which is far less than suitable. However, precipitation is very intense in the winter, and may reach 50% i.e. 30% in excess of the required limit.

In the spring, on the other hand, when plants need the water to blossom, the precipitation may be may be only 25% i.e. half the required amount of 50%.

4.5. Natural Resources in the Project

4.5.1 Types of soil

It is the upper layer of the soil that usually supports plant growth. Soil is described as a renewable source for agricultural processes that will never run out provided that it is used in an ideal way by proper ploughing and regular fertilization. Soil can be defined as the uppermost loose part of the earth`s crust. It has undergone chemical changes and has become mixed with organic materials, liquids and gases, and as a result has become suitable for plant growth.

Soil can be divided into two types in terms of its origins:

1- Local soil: this originates from the disintegration of rocks by weathering.

2- Transported soil: this originates somewhere else, and is then carried by water or winds to other places.

From a geological point of view soil forms by the transformation of the rocks of origin. These rocks include carbonate rocks, gypsum, granites and sandstone. However, soil experts point out that one material of origin can produce different kinds of soil depending on the environmental factors prevailing during the transformation processes particularly climatic factors, plant cover and the living organisms.

In Libya the following types of soil exist:

1- Sandy soil: land is described as sandy when it contains 85% or more of sand grains, provided that clay is not more than 10%. Sandy soil is usually poor in nutrients with a tendency not to retain humidity. Sandy soil is usually vulnerable to water and wind weathering.

2- Carbonate soil: rich in calcium carbonate. The calcium carbonate content may be in excess of 10%. This type of soil is mainly characterised by surface cracks and some degree of stiffness. It is poor in nutrients as well as basic elements.

3- Sedimentary soil: this is the flood-transported soil characterised by its high fertility and perfection. The soil of the study region (Al-Jafara plain), apart from the sand dune-covered northern part, belongs to this type.

4- Salty soil: this is characterised by its highly salty nature, and is therefore not suitable for crops. This kind of soil is especially abundant in oasis regions and in sabkhas all over the country.

5- Desert soil: this type of soil is usually sandy due to environmental and climatic conditions. This type of soil is prevalent in the Libyan Desert.

4.5.2. The Soil of Wadi Al-Hai Project

Previous studies have shown that the prevailing climate in the area is of a poor steppes semi desert climate. The annual precipitation ranges between 150 to 200 mm. However, the rains gradually decrease as we move west of Bir Al-Gahnam until absolute desert conditions prevail in the western part of Jafara plain.

The climate becomes semi arid where the rains range between 150 to 200 mm, a clear indication that the prevailing climate in the study region is semi desert.

A soil study conducted by a Yugoslavia based company, Hydrobrakt, confirmed that the soil in this region is a reddish brown desert soil that is suitable for crops. However, Wadi Al-Hai settlement project is adequate in other types of soil such sandy, sandy clay and clay soils. The clay soil is located midway in the project from north to south as the result of deposition by Wadi Zart. As we move outwards, the clay soil gradually turns into sandy clay until it becomes pure sand in the outer surroundings.

4.5.3. Soil Productivity

The suitability of soil for plant growth constitutes the overall outcome of its chemical and natural characteristics. The quality of land is mainly a factor of its productivity, which depends on soil variation as well as the diversification of crops and plants that it sustains. Furthermore, the soil formation and its capability of supplying the necessary nutrients and organic materials for plant growth within certain climatic conditions is an important factor that determines soil productivity.

With regard to productivity the soil can be classified as follows:

4.5.3.1. Class one soil: highly productive and suitable for all crops and fruits.

4.5.3.2. Class two soils: good productivity and suitable for crops and fruits.

4.5.3.3. Class three soils: of moderate productivity, only suitable for some crops and fruits.

4.5.3.4. Class four soils: productivity is low and only suitable for a limited number of crops, but not forests and grasslands.

4.5.3.5. Class five soils: not suitable for any agricultural activities.

With regards to the project the soil can be divided into the following categories:

4.5.3.6. Class two lands: including all of the first stage and part of the second stage. This the most significant type of soil in the Wadi Al-Hai region. This type is further divided into the following subdivisions, some of which are found in Wadi Al-Hai:

A- The first subdivision: most of the land inAl-Jafara plain, whether artificially irrigated or otherwise, belongs to this category, where parts of it have been used for agricultural purposes. This type of soil requires certain provisions prior to use, such as leveling, introduction of barriers, water supply for irrigation and the use of fertilizers. Its most important feature is that it is salt-free. It is suitable for barley, wheat (provided there are adequate rains) and is also suitable for almond, peach, fig, olive and pomegranate trees. Moreover, it could be suitable for vegetables and different animal feeds provided that enough water is available for irrigation.

B- The second subdivision is more widely distributed than the one above. It is generally an imported soil, which can be ploughed with ease, of sandy clay in nature, thick, providing good drainage and yet very low in nutrients. This is suitable for wheat, barley, almonds, peaches and vineyards. The main characteristic of this soil is that trees over one year old do not need artificial irrigation, although vegetables do.

C- The third subdivision covers all of the western side of the project and is distributed all over the northeastern part of the second stage. This kind of soil is readily saturated with humidity, with good permeability and good drainage. It is suitable for wheat, barley and fruits such as almonds, olives, peaches, date

palms and vineyards. Also, in cases of adequate water sources, it could be suitable for vegetables and green animal feed. It is poor in some nutrients, which can be compensated for by organic and inorganic fertilizers.

4.5.3.3. Class Three Lands:

These are of moderate productivity and are widely distributed in the second stage in the northeastern part of the project, and a small area in the first stage to the west. It comprises the following subdivisions:

A- The second subdivision of the third: this is the most common type of soil in wadi Al-Hai project, and is mainly sandy and sandy clay. It is slightly vulnerable to water and wind weathering, and is poor in organic material and low in nutrients. However, the sandy soil is less capable than the sandy clay of retaining moisture. It is most suitable for wheat and barley, and also vegetables and animal feeds provided adequate sources for irrigation are available. This type of soil also needs treatment with organic and mineral fertilizers such as nitrates and phosphates. In the case of fruit trees the upper calcite layer needs to be broken up before planting the seedlings to make it easy for the roots to penetrate.

4.5.3.4. Class Four Lands:

These belong to the first subdivision. They mainly exist outside the project, and their existence is very limited within the project. They are characterised by their rocky nature, specially the upper part. This type of soil is used within the project and outside for grains and animal feed. It very poor in organic material, and is

low in nitrogen and phosphorous, and therefore needs to be treated with fertilizers to compensate for these elements. This soil is suitable for crops, vegetables, and fruits in the case of suitable water sources for irrigation.

4.5.4. Water Resources for Irrigation

Water is basic for the life of every organism. The social and economic future of the whole of humanity would be in doubt without water. Water, so to speak, is the source of all food materials and raw products that keep our factories going.

Yet, in the aftermath of the increasing consumption of water in the last few years, due to the huge population growth and the rapid development that is taking place in all walks of life, the problem of finding adequate water resources is getting more serious. It is obvious that shortages in water resources will make people less reliable on the land, and therefore this is likely to hamper agricultural activities.

4.5.5. The Main Water Resources for Wadi Al-Hai Project

4.5.5.1. Rain Water

Rainwater is classified as top quality when it has low levels of dissolved salts. However, the rainwater that reaches the project is divided into two types according to the amounts and the methods of conveyance:

4.5.5.1.1. Type One

This type represents direct precipitation on the project estimated at 200 mm per year. This amount is adequate for major crops such as wheat and barley.

However, it could also be suitable for fruits such as almonds, peaches, olives and vineyards. These fruits could be successful in moderate precipitation given the fact that they are drought resistant. But nevertheless a complementary source of irrigation must be available.

4.5.5.1.2. Type Two

This type usually reaches the project in the form of floods originating from dams. However, despite being vital to agricultural activities, most of the water is wasted, and it is yet to be properly used, even partially so. The floodwater flowing into the valleys is estimated at 5% of the total rainwater, whereas the total amount of water flowing into Al-Jafara plain is estimated to be around 340 million cubic metres.

Some factors, such as infiltration and evaporation, tend to affect the original amounts of water when they are active. For example, infiltration depends on the type of soil, and ranges from 37.9% for clay soil to 40.5% for sandy clay and more than that for sandy soil. Drought also affects the amount of water as it activates the process of evaporation.

4.5.5.2. Ground Water

In a general sense agriculture in Libya is totally dependent on the ground water, especially in the remote southern regions far from the coast, where the rains become meagre. Hence the government has stepped up its efforts for ground water exploration. As a result of these efforts a number of wells have been dug, ranging in depth between 1000 and 2000 metres. Due to the adequate amounts

of water produced by these wells, a number of agricultural projects have been established including wadi Al-Hai settlement agricultural project.

Besides rainwater this project is partially dependent on ground water, which has been of great significance to the project especially prior to the completion of wadi Zart dam.

The ground water for the project is produced from the following formations:

4.5.5.2.1. Rubai Group

This formation is found all over the area, and the clay seal made it possible for this formation to retain water, which results in a number of springs within the valley.

This formation is located precisely north of the equivalence line (37.79). This line passes through the project service village to the east and west. To the south of this line no ground water exists in the quaternary formation, which only carries surface water from rainwater seepage.

4.5.5.2.2. Abu Shaiba Formation

The water is found in sandstone rocks. The water in this formation flows partially to the north towards wadi Al-Hai.

4.5.6. Methods of Irrigation

The importance of water for plants stems from the fact that all nutrients in the soil reach plant tissues dissolved in water. Water is the source for the hydrogen necessary for photosynthesis. Therefore, adequate sources of water whether

surface, ground or rainwater is a prerequisite for the success of agricultural processes anywhere on the globe.

However, crops cannot rely on rainwater only, except in the rainy season, despite rainfall being in regular and not evenly distributed. This makes it necessary to look for other potential sources of water, and yet the different methods of irrigation will make it possible to produce a variety of crops as well as green animal feeds in the dry seasons. By using artificial irrigation, more water could be available for crops and fruit trees than rainwater every year, especially in places where the rainwater is meagre.

Water requirements are estimated at 228 cubic metres (Agricultural Research Center, 1986) per field every time. Field surveys have shown that every single field needs irrigation once every six days on average.

The main methods used for irrigating the project are spraying, dripping and flooding.

4.5.6.1. Irrigation by Spraying

This method is used to irrigate fields of areas around 2.16 and 1.75 hectares in the first and second stages respectively, covered with fruits, vegetables, animal feed and wheat. This method is most appropriate for the irrigation of level ground, and also for lands with good drainage. This method will also assist the soil to absorb the water without being removed. The area irrigated by this method a mounts to 345.7 hectares in the first stage and 337.75 hectares in the second stage, which makes the total area irrigated by spraying 683.45 hectares.

4.5.6.2. Irrigation by Dripping

This method is used to irrigate fruit trees such as vineyards, figs and date palms. The areas irrigated are 4.34 and 5 hectares in the first and second stage fields respectively. This is one of the most highly technologically advanced methods used in the world. It is mainly based on the extension of plastic pipes 2 cm across from a major pipeline along the plantation line. Then at each tree location along the line, water drips through tiny holes in the tubes during the period of irrigation at a rate of 2 to 4 litres per hour.

The advantages of this method are:

1- Water is directly conveyed to the plant roots.

2- It restricts the potential loss of nutrients that could take place by washing the soil away, as is the case with the spraying method.

However, this method is easy to use and saves money and effort compared to other methods. Yet, some inherent flaws include the need for continuous maintenance of the tubes, especially the drippers which could possibly be blocked by the accumulation of salts and clays.

4.5.6.3. Irrigation by Flooding

This method is limited to the irrigation of fruit trees such as figs, olives and wind barriers, especially during the first two years of their development. This method mainly uses water tanks carried on tractors, but its use is very limited.

For every four farms there exists a central tank. This tank is supplied with water though a main pipeline running from the well. Then every one of the four farms is irrigated by plastic pipes110 cm across coming from the central tank.

4.5.7. The Situation of Water within Wadi Al-Hai Project

4.5.7.1. Drinking Water

The quality of drinking water is one of the main problems facing the project beneficiaries. However drinking water is available from two sources, one of which is well no. 10 in the first stage that is currently out of use, and the other source is well no. 23 in the service village. Nevertheless, the second well remains under great pressure all through the day due to its use by companies and middlemen, and this makes it susceptible to sudden breakdown at any time.

4.5.7.2. Water for Irrigation

This is becoming a common problem for all beneficiaries of the project. According to the economic statistics, which will be discussed later, this problem has severe negative effects. One of these effects is that 3 hectares of every field is left unused due to shortages in water. This shortage in irrigation water stems from the fact that 20 out of the 36 wells in the first stage are out of service, either having run dry or for other technical reasons. On the other hand, the 15 wells currently in use cannot cover the 160 fields or so of the first stage. For this reason the water allocations for every field will not exceed 5 hours every four days.

However, the second stage fields are divided into two groups: the first group, which comprises 55 fields and the second group, which comprises 100 fields. Yet, given that there are only 20 wells available, the water produced by these wells will be inadequate for the irrigation of even 3 hectares per field. Therefore this limited water is mainly used for the irrigation of fruit trees which rely on the dripping method. Moreover, only very limited amounts of this water are available for the production of vegetables and crops for self-sufficiency provided that the natural conditions are favourable. The outcome will be insignificant or it will even be impossible to produce these crops and vegetables in the event of windy and very hot conditions.

According to field surveys the annual precipitation is equivalent to 200mm.
It is obvious that natural conditions play a major role in the success or failure of the project. For example, the semi dry conditions that prevailed during 2002 – 2003 have seriously damaged the fruit trees, cereal crops and forage.

4.6. Housing Conditions of the Farmers

Farmers are housed in units of four houses facing each other. These housing units are located in one of the corners overlooking the paved road tress-passing the fields.

However, the location of the houses with respect to the fields is greatly significant in saving time spent on movement by the residents to and from the fields. Moreover, the nearer the house to the field, the more dedicated the farmer becomes to his land. This will enable the whole family to take part in different

farming activities such as trimming the trees, fruit collection and monitoring irrigation.

However, modern housing represents a major transformation in the living standards of farmers who used to have inadequate and unhealthy residences. The total area allocated for housing in each field is 157.95 sq m. Each home is made up of a 16 sq m space in front, a small outer bathroom, a large central hall, three bedrooms, a kitchen, a toilet and a storeroom. However, the main defect in these houses is that they are not properly oriented to allow sunlight in during daytime. Nevertheless all the necessary utilities are attached to the house. These utilities include a warehouse for the storage of crops, and another for the storage of forage, an enclosure for animals, a shed for farming equipment and machinery in addition to an underground reservoir for drinking water.

4.7. Social Services at the Project

These services include a school to provide basic education for the children, and health services including clinics, doctors, nurses and medicines. However, other services include a public market and mosques distributed all over the project, besides a post office and a police station. However, an office for rural development has also been operating with the purpose of helping the farming families especially the female family members, training them in the most vital farming operations.

However, the life of the farmers in the project has undergone significant change. This change has been reflected in the improving socio-economic conditions of

the project inhabitants, to the extent that most of the farmers now use state of the art equipment in their daily activities. This equipment includes modern cars, kitchens, electronics, TVs and videos, and even top of the range mobile phones.

4.8. Conclusion:

Wadi-Al-Hai settlement project is located 85 km to the south of the capital Tripoli. This project occupies a total area of 12,000 hectares of the so-called Jafara Plain. Due to the lack of natural barriers to the north, the prevailing climate in the area is directly affected by the Mediterranean moderating the temperatures and reducing the effects of the semi-desert climate in the south. However, most of the time the winter rains affecting the region are carried to it by the humid winds originating in the Atlantic to the west moving in an easterly direction towards the neighbouring highlands that allow the flow of rainwater into the project areas.

Nonetheless, this soil has been classified into five categories ranging from the highly productive class one soil suitable for all types of crops to a poorly productive class five soil barely suitable for any agricultural activities.

Rainwater constitutes a main source for irrigation, which either precipitates directly in the project or indirectly floods the project through a dam established for this purpose. Other sources include ground water, with different methods of irrigation involved such as spraying and dripping.

Two stages are involved regarding agricultural activities within the project. These are the first and second stages with 160 and 257 fields in each of them

respectively. The agricultural activities are directly affected by the natural conditions especially the lack of rains as is the case with the drought that has hit the area during 2002-2003 causing great damage to crops.

However shortages in drinking water are one of the major problems facing the inhabitants of the project, and therefore the need for more wells to provide clean water for drinking is urgent. Moreover, water for irrigation is suffering from severe shortages to the extent that 3 hectares on average of every field are normally left unused. This problem stems from the fact that almost half of the wells are either going dry or are not operating due to technical faults.

Yet, despite its problems the project has been, so far, of great benefit to the farmers by improving their quality of life. This has been obvious from the services it has provided to this group of rural inhabitants including decent housing, electricity, and health and education services.

CHAPTER FIVE

DATA ANALYSIS

5.1. Introduction

Agriculture always represents the core of rural development. However, modern agriculture usually involves mixed farming, where animals are equally important. The main purpose of mixed farming is to make the farmer self-sufficient in basic food products, as well as keeping them busy enough to not consider moving into the cities and towns. In other words mixed farming is likely to create stability in rural areas by preventing the migration of the rural population. With all this in mind, the planners and policymakers have introduced mixed farming into the Wadi-Al-Hai project. However, this has been a success so far, as the project has become a main supplier to the western region of food materials including milk, vegetables, meat and cereals.

Yet, generally speaking agriculture still has a long way to go in order to contribute effectively to the national income. This puts more pressure on the government of Libya to establish similar projects in other parts of the country. If successful, this plan will eventually boost other economic activities such as the food industry.

This chapter analysis and discusses the data using descriptive economic analysis of questionnaire responses concerning agriculture and animal production, the kind of fertilization used in production, the approved crop formation compared to the crop formation used for the season 2002-2003,the agricultural machinery used in the farms, marketing, the work force in the project, agricultural co-operatives and their services for the farmers, the advisory services, family expenditure, and the economics of the farms

including the costs of production, total and net income from the farms, the main agricultural features of the project and the desires and ambitions of the farmer's sons for the future.

5.2. Agricultural Production

The basic factors that influence agricultural production are:

1- Many factors positively or negatively influence agricultural production. Some of these factors such as climate and rains are environmental. However, a quick glance at the results of the statistical analysis for the season 2002-2003 shows that production is directly affected by drought.

2- The human factor relates to the extent that farmers can cope with modern technology, such as the use of genetically modified species with high productivity, the rational use of water in the irrigated areas, the use of the right equipment and avoiding the old traditional methods which only focus on soil fertility and productivity.

For a farmer to secure a suitable source of income to sustain his family, he must keep production at a maximum.

With regard to Wadi Al-Hai, farming products can be divided into the following categories:

5.2.1. Crop Production

Cereals contribute greatly to the farmer's income. Nonetheless, given the fact that cereals are grown within the rain-irrigated area, their production is greatly affected by the amount and distribution of precipitation both in time and place.

The low productivity recorded in this region in 2002-2003 was due to inadequate rainwater, which greatly affected the production of cereals.

Field surveys also revealed that the production per field in both stage one and stage two areas focused only on barley and forage, whereas wheat was completely left out because of the inadequate rainwater.

The average production of cereals (barley) and forage per hectare was approximately 0.5 and 0.1 tone respectively plus 17 bales of hay for the first stage farm, and 0.6 tone of barley and 17 bales of hay for the second stage farm as shown in Table 5.1.

Table 5.1: Average Production per Hectare from Crops in One Farm 2002-2003

Crop	First stage farm		Second stage farm	
	Production		Production	
	Ton	Hay bale	Ton	Hay bale
Barley	0.5	17	0.6	17
Forage	0.1	17	-	17
Total	0.6	34	0.6	34

Source: - Collected and calculated from the questionnaire

Cereal production in the first stage farm was around 1.35 tons of barley, 0.16 ton of forage and 73 bales of hay. For the second stage farm, production was around 1.5 tons of barley and around 72 bales of hay, given that the farm used is 4.3 and 4.2 hectares for the first and second stages respectively, as shown in Table 5.2.

Table 5.2: Crops and Forage Production in One Farm 2002-2003

Crop	First stage farm					Second stage farm				
	Hectare production		Total area (Hectare)	Total Production		Hectare Production		Total area (Hectare)	Total Production	
	Ton	Hay bale		Ton	Hay bale	Ton	Hay bale		Ton	Hay bale
Barley	0.5	17	2.7	1.35	46	0.6	17	2.5	1.5	43
Forage	0.1	17	1.6	0.16	27	-	17	1.7	-	29
Total	0.6	34	4.3	151	73	0.6	34	4.2	1.5	72

Source: - Collected and calculated from the questionnaire

The total production of the project was around 216 tons of barley, 25.61tons of forage and 11,680 bales of straw in the first stage, whereby for the second stage the production of barley was around 385.5 tones in addition to 18,504 bales of hay as shown in Table 5.3.

Table 5.3: Crops and Forage Production in Wadi Al-Hai Project 2002-2003

Crop	First stage					Second stage				
	Farm production		Number Of The farms	Total Production		Farm Production		Number Of The farms	Total Production	
	Ton	Hay bale		Ton	Hay bale	Ton	Hay bale		Ton	Hay bale
Barley	1.35	46	160	216	7360	1.5	43	257	385.5	11051
Forage	0.16	27	160	25.6	4320	-	29	257	-	7453
Total	1.51	73	-	2416	11680	1.5	72	-	385.5	18504

Source: -Collected and calculated from the questionnaire

Given the price of barley is around LD 200 per tone and LD 2.5 for a tone of forage or a bale of hay, then the total earnings from cereals and forage will be as follows:

Table 5.4: Total Income from Crops and Forage per Farm for 2002-2003

Crop	First stage farm			Second stage farm		
	Production (Tons)	Price per ton* (Dinars)	Total (Dinars)	Production (Tons)	Price per ton (Dinars)*	Total (Dinars)
Barley	1.35	200	270	1.5	200	300
Forage	0.16	200	32	-	-	-
Hay bale	73	2.5	182.5	72	2.5	180
Total	-	-	484.5	-	-	480

Source: - Collected and calculated from the questionnaire

* The prices were taken from the public markets according to the study season (2000- 2003).

From the table above it is clear that the total income per farm from barley, forage and hay were around LD 484.5 and LD 480 for the first and second stage farms respectively.

5.2.2. Fruits Production

The fruit plantation of wadi Al-Hai relates to the moderately warm and moderately cold regions. These fruits suit local environment factors such as soil and climate. Hence large areas of the fields are allocated to fruit in order to meet the increasing demand from local residents, and residents of the western region as well as markets in general. Therefore the allocation of large areas for fruit should be economically feasible and should eventually improve the standard of living for the farmers. However, with respect to the meagre rains and the inadequacy of irrigation water during the 2002-2003 season (the study period) and also due to the scant attention paid by the farmers to processes such as fertilization, preventive spraying with pesticides and ploughing unrepairable damage occurred to the fruit trees, especially the rain-dependent trees such as peaches and almonds as well as some of the irrigated fruits. The only fruits left were vineyards, figs, date palms and olives, though at lower numbers compared to the normal crop formation.

The production per hectare of the first stage farm was 1.6 tons of grapes, 0.6 tons of figs, 0.8 tons of palm and 53.1 litres of olive oil. For the second stage farm the production was 2 tons of grapes, 1.1 tons of figs, 1.4 tons of palm, and around 44 litres of olive oil, as shown in Table 5.5.

Table 5.5: Average Production per Hectare of Fruit in One Farm 2002-2003

Crop	First stage Farm		Second stage Farm	
	production		Production	
	Tons	Litres	Tons	Litres
Grape	1.6	-	2	-
Fig	0.6	-	1.1	-
Palm	0.8	-	1.4	-
Olive	-	53.1	-	44
Total	3	53.1	4.5	44

Source: - Collected and calculated from the questionnaire

It is obvious that the productivity of the second stage farm was greater than the first stage farm. This was due to the higher numbers of trees in the former compared to the latter.

The production of the first stage farm was around 1.6 tons of grapes, 0.6 tons of figs, around 0.8 tons of palm and 520 litres of olive oil, compared to 2 tons of grapes, 1.32 tons of figs, 1.4 tons of palm and 422.2 litres of olive oil for the second stage farm. The area allocated for the fruit was around 12.8 hectares in both the first and the second stage farms as shown in Table 5.6.

Table 5.6: Fruit Production in One Farm 2002-2003

Crop	Farm of the first stage						Farm of the second stage					
	Number of Trees	Production per Hectare		Total Area (hectares)	Total production		Number of trees	Production per Hectare		Total Area (hectares)	Total production	
		Ton	Liter		Tons	Litres		Tons	Litres		Tons	Litres
Grape	230	1.6	-	1	1.6	-	285	2	-	1	2	-
Fig	109	0.6	-	1	0.6	-	149	1.1	-	1.2	1.32	-
Palm	31	0.8	-	1	0.8	-	80	1.4	-	1	1.4	-
Olive	186	-	53.1	9.8	-	520.4	176	-	44	9.6	-	422.4
Total	556	3.0	53.1	12.8	3.0	520.4	663	4.5	44	12.8	4.72	422.4

Source: - Collected and calculated from the questionnaire

The total production of fruit for the whole project is estimated at 256 tons of grapes, 96 tons of figs, 128 tons of palm and 83264 litres of olive oil in the first stage, compared to 514 tons of grapes, 339.24 tons of figs, 359.8 tons of palm and 108556.8 litres of olive oil in the second stage as shown in Table 5.7.

Table 5.7: Fruit Production in Wadi Al-Hai Project 2002-2003

Crop	First stage					Second stage				
	Farm production		Number Of The farms	Total Production		Farm Production		Number Of The farms	Total Production	
	Tons	Litres		Tons	Litres	Tons	Litres		Tons	Litres
Grape	1.6	-	160	256	-	2	-	257	514	-
Fig	0.6	-	160	96	-	1.32	-	257	339.2	-
Palm	0.8	-	160	118	-	1.4	-	257	359.8	-
Olive	-	520.4	160	-	83264	-	422.4	257	-	108566.8
Total	3.0	520.4	-	480	83264	4.72	422.4	-	1213.0	108566.

Source: - Collected and calculated from the questionnaire

Given prices of LD 650 per ton of grapes, LD830 per ton of figs, LD 734 per ton of dates and LD 2.5 per litre of olive oil, then the total earnings from fruits is as follows:

Table 5.8: Total Income from Fruit per Farm for 2002-2003

Crop	First stage farm			Second stage farm		
	Production (ton)	Price per Ton/litre (dinars)	Total (dinars)	Production (tons)	Price per Ton/litre (dinars)	Total (dinars)
Grape	1.6	650	1040	2	650	1300
Fig	0.6	830	498	1.32	830	1095.6
Palm	0.8	734	587.2	1.4	734	1027.6
Olive	520.4 litre	2.5	1301	422.4 litre	2.5	1056
Total	-	-	3426.2	-	-	4479.2

Source: - Collected and calculated from the questionnaire

* The prices were taken from the public markets according to the study season (2000- 2003).

From the table above it is obvious that the total income of one farm from fruits were LD 3,426.2 in the first stage and around LD 4,479.2 in the second stage.

5.2.3. Vegetable Production

The importance of vegetables stems from the fact that earnings from their are fast and direct.

However, vegetables are very vulnerable plants, and they need more attention since any shortages in water or fertilizers are likely to have negative effects on both the quality and quantity of the products. The questionnaire data shows that the vegetable production is mainly focused on onions, watermelons and tomatoes. However, the purpose of vegetable production is mainly to achieve self-sufficiency for the project population, and then the surplus will be marketed, and for this reason vegetable production is limited.

The vegetable production was around 12.6 tons per hectare and 12.6 tons per hectare for the first and second stage farms respectively as shown in Table 5.9.

Table 5.9: Average Production per Hectare of Vegetables in One Farm 2002-2003

Crop	First stage Farm	Second stage Farm
	Production (tons)	Production (tons)
Onion	5.3	4.2
Watermelon	7.3	3.3
Tomato	-	5.0
Total	12.3	12.5

Source: - Collected and calculated from the questionnaire

With regard to the production of vegetables per farm, this averaged 5.3 tons of onion, and 10.95 tons of watermelons in the first stage, compared to 4.2 tons of onions, 6.6 tons of watermelons and around 5 tons of tomatoes in the second stage. The land allocated for vegetables was around 3.5 hectares and 4 hectares in the first and second stages respectively, as shown in Table 5.10

Table 5.10: Vegetable Production in One Farm 2002-2003

The crop	First stage farm			Second stage farm		
	Production per Hectare (tons)	Total Area (hectares)	Total Production (tons)	Production per Hectare (tons)	Total Area (hectares)	Total Production (tons)
Onion	5.3	1	5.3	4.2	1	4.2
Watermelon	7.3	1.5	10.95	3.3	2	6.6
Tomato	-	-	-	5	1	5
Total	12.6	3.5	16.25	12.5	4	15.8

Source: - Collected and calculated from the questionnaire

The total vegetable production in the project was around 848 tons of onions, and 1,752 tones of watermelons in the first stage compared to 1,079.4 tones of onions, 1,696.2 tons of watermelons and 1,285 tons of tomatoes in the second stage, as shown in Table 5,11.

Table 5.11: Vegetable Production in Wadi Al-Hai Project 2002-2003

crop	First stage farm			Second stage farm		
	Farm production (tons)	Number Of Thefarms	Total Production (tons)	Farm production (tons	Number Of The farms	Total Production (tons
Onion	5.3	160	848	4.2	257	1079.4
Watermelon	10.95	160	1752	6.6	257	1696.2
Tomato	-	-	-	5	257	1285
Total	16.25	160	2600	15.8	257	4060.6

Source: - Collected and calculated from the questionnaire

Given the prices of LD 169 and LD 200 for a ton of onions and a tone of watermelons respectively, and LD 200 for a ton of tomatoes then the total revenue from vegetables was as follows:

Table5.12: Total Income From Vegetables per Farm 2002-2003

Crop	First stage farm			Second stage farm		
	Production (tons)	Price per ton * (dinars)	Total (dinars)	Production (tons)	Price per ton * (dinars)	Total (dinars)
Onion	5.3	169	895.7	4.2	169	709.8
Watermelon	10.95	200	2190	6.6	200	1320
Tomato	-	-	-	5	200	1000
Total	16.25	-	3085.7	15.8	-	3029.8

Source: - Collected and calculated from the questionnaire
*The prices were taken from the public markets according to the study season (2000-2003).

From the previous table it is obvious that a single farm earned around LD 3085.7 in the first stage and around LD 3029.8 in the second stage.

The above study suggests that productivity is relatively low. However, improving the water resources for irrigation as well as improving the quality of

soil by adding the right types and amounts of fertilizers and chemicals could improve agricultural productivity. Moreover productivity could also be improved by using good quality seedlings and by overcoming the shortages in labour by more mechanisation. One of the reasons for low productivity is that the farmers do not comply with the agreed crop formation plan, in addition to lack of knowledge of agricultural processes with regard to the timing and methods of combating pests.

From the foregoing it can be concluded that the current crop formation used in Wadi Al-Hai project is based on fruits as the main product with other crops and vegetables as subsidiaries. However, from a technical point of view this does not constitute proper crop rotation. Yet, for proper crop rotation to be established, more technical and economic studies need to be conducted in order to find the best combination of crops that will give a viable crop rotation. This will eventually help preserve the soil and improve resources so that the socio-economic objectives can be achieved at both the individual and the national levels. However, it is worth mentioning that the considerable concern shown by the state in sorting out problems associated with production should encourage farmers to use the available resources in the best way to improve production. These problems include the workforce, mechanization, providing production materials such as fertilizers and insecticides and problems related to irrigation, sewage and soil fertility. Addressing these problems in a more serious manner should definitely enhance production, leading to reasonable levels of self-sufficiency and food security at the national level, and should

improve the wellbeing of farmers by increasing their incomes, which should help improve the living standards of their families.

5.3. Animal Resources

Animal farming is one of the main economic activities in the study area. The significance of animal farming stems from the fact that it generates huge incomes to farmers both in kind and cash. However, the fact that animal farming is closely related to agriculture leads farmers to simultaneously engaged in two activities. This kind of agricultural activity is known as mixed farming. By selling animals and their products farmers should be able to generate additional income. Moreover the farmer's family will be self sufficient in animal products such as milk, butter, and meat, and yet in some cases animal farming is limited to fattening animals and selling them for cash.

However, the increasing demand for animal products, and especially meat, urges the farmers to pay more attention to animal farming. Hence, regarding the development of animal farming and the augmentation of animal production, the cultivation of forage becomes paramount, especially with respect to the inadequacy of the natural grasslands and its poor nutrient content.

Another important advantage associated with mixed farming is that it can make use of cheap cereals such as wheat and barley for feeding animals, and hence increasing their prices. Also in addition to the animal per se as a source of income, its waste also constitutes a main ingredient in organic fertilizers. Furthermore the animals will consume all the leftover vegetables and other

products that cannot be marketed, and therefore in this sense the animal becomes part and parcel of the farm.

However, as far as Wadi Al-Hai is concerned, sheep and goats constitute the main elements of animal farming. According to the field surveys sheep farming comes first, which makes goat farming less important. The numbers of sheep are around 22 and 26 heads in the first and second stage farms respectively, with total costs of LD 944.7 for the first stage and LD 1,091 for the second stage. In the meantime the earnings of from first stage farm are LD 957.1 compared to LD 1,227.5 for the second stage farm.

As for goats, the average number in the first stage farm is around 12 compared to 19 in the second stage farm, with a total cost of LD 276.9 and LD 553.8 for first and second stage farms respectively. However, total earnings are LD 300 for the first stage farm and LD 650 for the second stage farm. In total the goats are 1,920 heads in the first stage and 4883 heads in the second stage, and the total numbers of sheep are 3,520 heads in the first age and 6,682 heads in the second stage.

Tables 5.13 and 5.14 show the average numbers of sheep and goats, the costs incurred and earnings per farm in LD at Wadi Al-Hai agricultural project.

Table 5.13: Number of Goats and Sheep, their Costs and Total Income in One Farm

Animal	First stage farm			Second stage farm		
	Number	Total costs (dinars)	Total income (dinars)	Number	Total costs (dinars)	Total income (dinars)
Sheep	22	944.7	957.1	26	1091.8	1227.5
Goats	12	276.9	300	19	553.8	650
Total	34	1221.6	1257.1	45	1645.6	1877.5

Source: - Collected and accounted from the questionnaire.

Table 5.14: Number of Goats and Sheep in Wadi Al-Hai Project

Animal	First stage farm			Second stage farm		
	Number of heads	Number of farms	Total	Number of heads	Number of farms	Total
Sheep	22	160	3520	26	257	6682
Goats	12	160	1920	19	257	4883
Total	34	-	5440	45	-	11656

Source: - Collected and calculated from the questionnaire.

From the tables above it can be noticed that goats come second to sheep in importance despite the fact that the local environment is suitable for goat farming in the open grasslands as well as in the enclosures attached to the farms. However, the activity and agility of goats is one of the main reasons that discourage farmers in the study region from breeding goats. Moreover goats tend to damage trees and give lower earnings compared to sheep.

5.4. Animal Production

5.4.1. Milk

The quantities of milk produced by an animal are proportional to the amount of feed consumed by it. Therefore the better the animal is fed the greater the amounts of milk produced. However, usually the productivity of milk for both goats and sheep increases in the winter and spring when the natural grasslands are available. The quantity of milk produced is also a function of the type of animal and its pedigree. The sheep in the project are not good milk producers. In contrast the quantities of milk produced by goats are far greater, despite their small number, and hence they can cover the family needs for milk without their young being affected. The average quantity of milk given by a first stage goat is 7 litres per day.

However, it is obvious that the farmers have opted to breed sheep in the project rather than cattle, of which there are none.

5.4.2. Meat

The importance of meat stems from the fact that it is the main source of protein essential for building the body. The quantity of meat produced depends on the animal population, and the amount of feed given to them in their natural environment determines the economic feasibility of the types of animals suitable for breeding. However, since sheep are the dominant animals in the area, they have become the main source of meat. In contrast chickens are non-existent, as the farmers have declined from poultry production.

5.5. Fertilization

5.5.1. The Importance of Fertilization

The natural soil, which consists of both organic matter and mineral elements, is the main source for nutrients essential for plant growth. These elements vary depending on the type of soil. For example the desert soil is poor in nutrients.

To stop the deterioration in soil fertility and to increase productivity the use of organic fertilizers has become inevitable. These fertilizers provide the soil with the necessary nutrients and consequently will tend to improve soil quality.

With regard to Wadi Al-Hai, the soil is deficient in some of the nutrients such as phosphates, and yet it is rich in others such as calcium as suggested by a study made by an ex-Yugoslavia based company Hydroproject.

However, to achieve the best balance for plant growth and a better economic outcome of crop production, it is advisable to use the following nutrients featuring chemical and organic fertilizers, to compensate for any potential nutrient deficiency and hence to increase productivity.

The most important soil fertilizers are:

5.5.1.1. Organic Fertilizers

5.5.1.1.1. The Organic Fertilizers of Animal Origin

These include all the solid and liquid animal waste and some of the plant waste, which is used as a cover for the stable grounds. The plant waste is rich in

nutrients and this helps to increase the bacteria and organic matter in the soil. In addition these plants will help to hold sandy soil together, improving permeability and helping to break up strongly cohesive soil.

The farmers dig deep holes especially for the purpose of leaving to ferment the waste produced by the great number of sheep and goats in the project. This fermentation will tend to destroy any potential weed seeds hence reducing the effects of these weeds on crops.

Moreover, parts of the mineral contents of these fertilizers will disappear by disintegration or infiltration into the soil. Hence these fertilizers may lose half their nitrogen and potassium contents, and at least half of the phosphoric acid contents.

This study has shown that all farmers tend to use animal waste produced in the farm as organic fertilizers. Nevertheless, the use of animal waste as fertilizers without initially being treated is the main cause for weeds that affect crops. Furthermore these weeds might cause the destruction of seeds prior to germination.

5.5.1.1.2. Green Organic Fertilizers

The need for providing crops with the necessary nitrogen and organic matter prompts the use of whatever is useful, including leftovers or material wasted from the harvest. Particularly important is what is known as green fertilizers.

These remains are left to disintegrate in the soil when conditions are right. Legumes are best given their high nitrogen content and easy disintegration.

However, the main advantage of green fertilizers is that they constitute the main source for hydrogen, besides which they improve the soil quality, increase its humidity and temperature, and its protect the soil from being washed away.

Clover (Alfa-Alfa), peanuts, lupines, black eye beans and oats are the main sources of green fertilizers. Yet, project farmers are encouraged to use animal organic fertilizers because they are cheaper and available in abundance.

5.5.1.2. Chemical Fertilizers

As long as the organic fertilizers are inadequate for wider use and their production is limited in the farm, then chemical fertilizers become more important. Chemical fertilizers are sound since they contain one or more of the elements essential for plant growth. Therefore more than one fertilizer needs to be added to compensate for deficient nutrients in the soil. These include nitrates, phosphates and potassium fertilizers.

However, field studies have shown that phosphates and ammonium sulphate are the most important fertilizers, with the use of super-phosphates being more frequent for crops, and ammonium for vegetables.

It was discovered that only 12.5 % in the first and 23.1% in the second stages of farmers used chemical fertilizers, and about 87.5 % and 76.9% respectively did not use these kinds of fertilizers, as shown in Table 5.15 Also, chemical fertilizers were often used for crops but to a lesser extent for vegetables and fruits.

Table 5.15. The Use of Fertiliser

Item	First stage farm		Second stage farm	
	Frequency	Percentage %	Frequency	Percentage %
Yes	5	12.5	15	23.1
No	35	87.5	50	76.9
Total	40	100	65	100

Source: - Collected and accounted from the questionnaire

5.6. The Approved crop Formation for the Project:

It was initially planned that the farms in the Wadi Al-Hai project should include two types of agriculture:

1. Rain agriculture

2. Irrigated agriculture.

It is clear that the first of these is dependent on rainwater, whereas the second depends on irrigation by ground water or by dams.

However, a certain crop formation was approved which may vary from one stage to another.

5.6.1. First Stage Farms

This farm was 25 hectares in area divided to nine small parts of varying areas. These parts were used as follows: 2 hectares for figs, 0.24 hectares for wire grapes, 0.5 hectares for date palms, one hectare for ground grapes and 2.16 hectares for vegetables, forage and irrigated wheat.

The rainwater fields included 1.5 hectares for peaches, 5 hectares for almonds and 10 hectares for olives.

The fields allocated for figs and almonds can also take on rain-irrigated wheat and barley every year.

5.6.2. Second Stage Farm

This is 25 hectares in area but is divided into seven parts used as follows:

2 hectares for figs, 2 hectares for ground grapes, one hectare for date palms and 0.75 hectares for permanently irrigated vegetables and forage.

The dry agriculture parts include 10 hectares for olives, and 9 hectares for cereals and grazing. The rain irrigated fields for figs also take on cereals.

5.7. Crop Formation for the Season 2002-2003

The questionnaire data shows that the crop formation in 2002-2003 included field crops, fruits and vegetables. Therefore the stages are dealt with separately as follows:

5.7.1. First Stage:

The crop formation in this stage includes cereal crops such as barley, forage, vegetables and fruits.

Table 5.16 below shows the crop formation in the first stage fields.

Table 5.16: Crop Formation for the First Stage Farm

2002-2003

Crop	Area (Hectares)	Percentage %
Crops and forage		
Barely	2.7	13.1
Forage	1.6	7.8
Fruit		
	1	4.9
Grape	1	4.9
Fig	1	4.9
Palm	9.8	47.6
Olive		
Vegetables		
	1	4.9
Onion	1.5	7.3
Watermelon		
Total	19.6	-

Source: - Collected and calculated from the questionnaire

From Table 5.16 shown above it can be concluded that the total area used for the first stage farm was around 19.6 hectares. However, of this area, 4.3 hectares was allocated for cereal crops (barley) and forage i.e. an equivalent of 20.9% of the total area. The area allocated for fruits was 12.8 hectares or 62.3% of the total area, and the area allocated for vegetables was 2.5 hectares or 12.2% of the total area.

The total area used in the first stage is around 3296 hectares.

5.7.2. Second Stage: the crop formation in this stage includes cereals (barley), forage, vegetables and fruits.

Table 5.17 shows the crop formation in the second stage farms.

Table 5.17: Crop Formation for the Second Stage Farm

2002-2003

Crop	Area (Hectares)	Percentage %
Crops and forage		
Barley	2.5	11.9
Forage	1.7	8
Fruit		
	1	4.8
Grape	1.2	5.7
Fig	1	4.8
Palm	9.6	45.7
Olive		
Vegetables		
	1	4.8
Onion	1	4.8
Tomato	2	9.5
Watermelon		
Total	21	-

Source: - Collected and calculated from the questionnaire

From Table 5.17 above it is clear that the total area used in the second stage farm was around 21 hectares. The area allocated for cereals (barley) and forage, was 4.2 hectares or 19.9% of the total area. The area allocated for fruits was 12.8 hectares or 60.9% of the total area, whereas the vegetables occupied an area of 4 hectares or 19.1% of the total area.

The total area used in the second stage was around 5397 hectares, and the total crop distribution in the project was as follows: for cereals (barley) and animal

feed around 3,544.5 hectares, 10,716.9 hectares for fruits and 3,127.5 hectares for vegetable.

Table 5.18: Comparison Between the Approved Crop Structure and the Crop Structure in the Season 2002-2003 for the First Stage Farm

First stage farm						
Approved crop structure (1)			Crop structure in the season 2002-2003 (2)			Percentage Implementation
Crop	Area (hectares)	Total Trees	Crop	Area (hectares)	Total Trees	%
Fig	2	200	Fig	1	109	54.5
Wire Grape	0.84	550	-	-	-	0
Ground Grape	1	500	Ground Grape	1	200	0
Palm	0.5	52	Palm	1	100	192.31
Vegetables and Forage	2.12	-	Vegetables And Forage	4.1	-	0
Almond	5	500	-	-	-	0
Peach	1.5	150	Barley	2.7	-	0
Olive	10	250	Olive	9.8	180	72
House	2	-	House	2	-	-
Total	25	-	Total	21.6	-	-

Source: - 1-Wadi Al-Hai project, the approved crop structural, First stage farm.
2-Collected and calculated from the questionnaire

Table 5.18 above indicates considerable differences between the crop formation approved by the project board and that of the season 2002-2003. However, all the almond and peach trees withered and therefore have been destroyed in an area of around 6.5 hectares. Hence only 2.7 hectares were used for cereals (barley), the area for figs was reduced from 2 hectares to only one

hectare, and the number of trees dropped from 200 in the approved formation to only 109 in the season 2002-2003. On the other hand the area allocated for the vineyard remained unchanged at around one hectare, and yet the number of trees dropped to less than half the original number. However, this huge drop was partly due to shortages in irrigation water, and partly to diseases that affected the plantation. Water shortages have also lead to the withering of the trees.

Although the climbing vineyards were completely destroyed, the area allocated for date palms increased twofold i.e. from 0.5 to one hectare, and the number of trees increased from 52 to around one hundred trees. Nevertheless the farmers concentrated more on vegetables and forage, and therefore the area allocated for these crops increased by nearly twofold i.e. from 2.16 hectares to 4.1 hectares. However, in the meantime the area allocated for olives shrank from to less than half i.e. from 10 to 4.8 hectares, and the total number of trees dropped from 250 to only 180 trees.

Table 5.19: Comparison Between the Approved Crop Structure and the Crop Structure in the Season 2002-2003 for the Second Stage Farm

Second stage farm						
Approved crop structure (1)			The crop structural in the season (2002-2003) (2)			Percentage Implementation
Crop	Area (hectares)	Total Trees	Crop	Area (hectares)	Total Trees	%
Fig	2	200	Fig	1.2	149	74.5
Ground Grape	2	150	Ground Grape	1	258	17.5
Palm	1	104	Palm	1	80	76..9
Vegetable and Forage	0.75	-	Vegetable and Forage	5.7	-	0
Olive	10	250	Olive	9.6	176	70.4
Grazing And Cereals	9	-	Grazing And Cereals	2.5	-	0
House	0.25	-	House	0.25	-	-
Total	25	-	Total	21.25	-	-

Source: - 1-Wadi Al-Hai project, the approved crop structural, second stage farm.
2-Collected and calculated from the questionnaire

The Table 5.19 above shows big differences between the crop formation approved by the project board and that for the seasons 2002-2003. It is obvious that the area allocated for figs shrank from 2 hectares in the approved formation to only 1.2 hectares in the season 2002-2003, and the number of trees dropped from 200 to 149 trees as a result of shortages in irrigation water. The allocated area for the ground grape shrank from 2 hectares in the approved formation to only one hectare for the season 2002-2003, and as result of water shortages, diseases and the lack of attention from the farmers, the number of trees dropped to less than 1,500.

On the other hand, the area allocated for date palms remained unchanged i.e. one hectare in both formations, but nevertheless the number of trees in the approved formation for season 2002-2003 dropped from 104 to 80 trees for the same reasons as mentioned before in the case of the ground grape.

However, the area allocated for vegetables and forage has expanded by 0.75 hectares to 5.7 hectares, which is a clear indicator that farmers have concentrated on vegetables in the second stage. Yet, the area allocated for olive shrank slightly from 10 to 9.6 hectares and the number of trees dropped from 250 to 176. Also only 2.5 hectares were used for barley from an area of 9 hectares allocated for cereals and grazing. Therefore the total area for the crop formation in the season 2002-2003 has been around 21.25 hectares, whereas the total area for the approved crop formation was around 25 hectares.

5.8. Agricultural Machinery:

The use of modern machinery is the most important element that characterises modern agriculture. The expansion of the cultivated land has become possible only through the use of modern machinery, which saves effort and time.
However, the most important machinery in processes such as ploughing and transport are the tractor.

In addition to the traditional 9-tooth plough, initially given to farmers, they have also received a tipper-plough, a field-trailer and a water-trailer.

Table 5.20: Agricultural Machines in the First Stage Farm

Item	Tractor	Pick up truck	Lorry	Sowing machine	Small Harvesting machine	Machine for forage pressing	Trailer
First stage	40	39	40	9	15	2	37

Source: - Collected and calculated from the questionnaire

Table 5.20 above shows that in 40 cases the farmers received all the necessary machinery such as tractors and pick-ups (100%), and in 39 cases they have received special transport vehicles (97.5%), Sowing machine in 9 cases (22.5%), small harvesters in 15 cases (37.5%), forage pressers in only 2 cases (5%) and trailers in 37 cases (92.5%).

Table 5.21: Agricultural Machines in the Second Stage Farm

Item	Tractor	Pick up truck	Lorry	Sowing machine	Small Harvesting machine	Machine for forage pressing	trailer
Second stage	65	62	65	14	35	7	43

Source: - Collected and calculated from the questionnaire

However, Table 5.21 indicates that in 65 cases farmers received a tractor and a pick-up (100%), special transport vehicles in 62 cases (95.4%), sowing machine in 14 cases (21.5%), small harvesters in 35 cases (53.8%), forage pressing in 7 cases (10.8%) and trailers in 43 cases (66.2%).

In terms of the whole project, tables 5.19 and 5.20 indicate that in 105 cases the most important machinery such as tractors and pick-ups were available for the farmers i.e. a (100%) rate of use. However, in 101 cases farmers received

special transport vehicles (96.2%), sowing machine in 23 cases (21.9%), small harvesters in 50 cases (47.6%), forage pressing in 9 cases (8.6%) rate and in 80 cases farmers received trailers (76.2%) rate.

Therefore from the data in Tables 5.20 and 5.21, it can be inferred that the shortage in important machinery in the first and second stages could have been due to a number of factors. Nevertheless the shortage of capital investment and the rarity of spare parts provided by retailers are the most important of these factors. Hence, this indicates that the project board and the agricultural society did not offer enough services in this field.

5.9. Marketing

Marketing is the transfer of goods from producers to consumers. Therefore a close relationship exists between production and marketing, and marketing becomes more important with increases in production.

However, the marketing process could be influenced by a number of factors, the most important of which is the nature of crop production. For example, some crops such as fruits and vegetables are vulnerable to damage, and therefore need urgent marketing. Likewise prices can affect the marketing process, whereby higher prices usually encourage farmers to produce. Nevertheless higher prices may have negative effects on demand as they discourage consumers on lower incomes. However, this is where price fixing becomes important, and yet this should take the interests of both consumers and farmers into consideration, so that the main objective of the project in

improving the living standards of farmers should not be neglected. Thus the establishment of reliable markets became crucial for the very existence of the project, and the strategic importance of marketing the products from the project is evident from the many sites available for marketing. Yet the questionnaire data has indicated that the marketing process takes place as shown in Table 5.22 below:

Table 5.22: Distribution of Agricultural Marketing sites for Wadi AL-Hai Project

sites	First stage		Second stage	
	Frequency	Percentage %	Frequency	Percentage %
General popular markets	25	62.5	54	83.1
In the farm	15	37.5	11	16.9
Total	40	100	65	100

Source: - Collected and calculated from the questionnaire

From Table 5.22 it is obvious that public markets are the most attractive, representing 62.5% of sites in the first stage and around 83.1% in the second stage. In contrast, local marketing within the farm premises has been less popular, representing 37.5% and around 16.9% in the first and second stages respectively. Yet, the importance of the public markets stems from the fact that they represent a rendezvous for farmers, brokers and middlemen, where the process of whole sale to these people saves time and effort for the farmers, and offers them the opportunity to sell their products for prices that suit them.

It was evident from the study survey that the use of small cars for marketing is very common among farmers. The distribution of vehicles in relation to marketing groups is as follows:

Table 5.23: Means Used for Production Marketing in the Project

Item	First stage		Second stage	
	Frequency	Percentage %	Frequency	Percentage %
Private car	36	90	53	81.5
Rental car	4	10	12	18.5
Total	40	100	65	100

Source: - Collected and calculated from the questionnaire

From Table 5.23 shown above it can be concluded that most farmers use their own cars for marketing their products. This represents 90% and 81.5% of the total means of transport used in the first and second stages respectively. On the other hand hired cars represent only 10% in the first stage and 18% in the second stage. Yet, this indicates that as far as marketing is concerned, logistics does not constitute any problem for the majority of farmers. However, the individuals responsible for the marketing of products are shown in Table 5.24 below.

Table 5.24: Who Markets the Agricultural Production in the Project?

Item	First stage		Second stage	
	Frequency	Percentage %	Frequency	Percentage %
The farmer	7	17.5	13	20
The sons	8	20	14	21.5
The farmer and sons	25	62.5	38	58.5
Total	40	100	65	100

Source: - Collected and calculated from the questionnaire

It obvious from the Table 5.24 shown above that the process of marketing products is mainly undertaken by the farmers and their children, who represent 62.5% in the first stage and 58.5% in the second stage. The children as marketers come second to their fathers, representing only 20% and 21.5% in the first and second stages respectively. On the other hand the farmers as lone marketers represent only 17.5% in the first stage and 20% in the second stage.

However, we notice the absence of agricultural co-operatives in the marketing process even though marketing represents one of its objectives. This would imply that the management of the co-operative should be more aware of the significance of co-operative marketing, as well as its methods and procedures.

5.10. The Project Workforce

From the field survey it is evident that the majority of the project inhabitants are students, who constitute 49.4% of the total project population. Nevertheless, the agricultural activities are practiced by only 12.2% of the total population, besides around 19.7% who practice handcrafts. On the other hand, around 18.3% of the total population are either employees or otherwise are engaged in managerial jobs within the project, and only 0.3% of the total population is unemployed, as shown in Table 5.25.

Table 5.25: The Kind of Jobs held by People in the Project

Type of job	Frequency	Percentage %
Agriculture	108	12.2
Employee	175	19.7
Administrator	162	18.3
Student	437	49.4
Unemployed	3	0.3
Total	855	100

Source: -Collected and calculated from the questionnaire

However, the location of residences within the project premises has allowed the female element, represented by the farmers' wives and daughters, to perform some tasks such as helping with farming activities. Moreover, the farmers' sons are likely to help with most of the simple activities such as

moving irrigation pipes, harvesting and marketing, especially during the summer vacation when the schools are closed.

As Table 5.25 indicates, those who perform farming activities are a minority of the population. Yet, given the fact that most crops require attention and hard work, this has led to the shrinkage of the cultivated land and reduction in productivity.

5.11. The Agricultural Co-operative

Both first and second stage farmers established this agricultural co-operative in 1978. Whereby every farmer had made a subscription of LD 25 towards its establishment. The 100% positive response to the question "are you a member of the co-operative?" is a clear indication that all farmers are members of the society.

However, some of the objectives of the agricultural co-operative, in rural areas in general, are to provide the farmers with the most essential services in agriculture. But nevertheless the activities of the co-operative should always be in harmony with its aims, including providing the necessary equipment and machinery, seeds, fertilizers, and pesticides, as well as marketing and giving advice to farmers on the nature of the markets available.

Table 5.26 shows the response of farmers to the question about the agricultural co-operative as a service provider.

Table 5.26: The Services of the Agricultural Co-operative to the Farmers

Service	First stage		Second stage	
	Frequency	Percentage %	Frequency	Percentage %
Adequate	3	7.5	8	12.3
Barely adequate	1	2.5	7	0.8
Inadequate	36	90	50	76.9
Total	40	100	65	100

Source: - Collected and calculated from the questionnaire

Table 5.26 indicates that the society provides only 7.5% and 12.3% of the required services in the first and second stages respectively and yet, only 2.5% of the first stage farmers and around 0.8% of second stage farmers believe that the society provides barely adequate services. In contrast around 90% of the first stage farmers and 76.9% of the second stage farmers believe that the society does not provide them with adequate services. That is a clear indication the society, whether in the first or second stage, does not provide the necessary required services. However, the main reason behind this failure may be shortages in finances and the rarity of the necessary agricultural materials.

Accordingly, as the farmers are interested in the services provided, the society should be encouraged and financially sponsored to improve its services to meet the requirements of farmers to their satisfaction.

5.12. Advisory Services

When the settlement scheme began, the council managed it for the Agricultural Development, which provided effective advisory services. However, since the project management was taken over by the Agricultural People's Committee for Wadi Al-Hai project, both the management and advisory services have deteriorated.

There is a shortage of staff and expertise, and the staff who are available have a low level of education and training, so that the quality of services is now poor. An administrative officer suggested to me that services had deteriorated because of a shortage of funds, along with frequent changes of staff that adversely affected the efficiency of the administration. Another relevant factor is the change of state policy towards farmers, resulting in the withdrawal of subsidies and financial help and leaving each farmer to depend on himself.

Therefore the task of agricultural supervisors is to offer guidance, to teach farmers how and when to fertilize their crops, and what quantities of these fertilizers should be added to the soil.

It has become obvious that the agricultural engineers working in the project have provided no supervision to the farmers. This conclusion is drawn from the answers of the farmers to question as to whether an agricultural engineer has visited their farms.

Table 5.27: Visits of the Agricultural Engineer to the Farms in the Project

Stage	Period					
	Daily	Weekly	Monthly	Without appointment	Does not come	Percentage %
First	-	-	-	-	40	100%
Second	-	-	-	-	65	100%
Total	-	-	-	-	105	100%

Source: - Collected and calculated from the questionnaire

From Table 5.27 it is clear that none of the farmers had seen the agricultural engineer visiting their farms. There are 105 cases with a 100% response.

From the foregoing it is evident that the agricultural engineer is totally absent. This is reflected in the poor knowledge of the farmers of agricultural processes. For this reason agricultural engineers must always be present in suitable numbers to offer supervision and advice to farmers, to enable them to cope with ever-changing agricultural techniques.

5.13. Expenditures by the Farmers` Families per Month at Wadi Al-Hai Project

The total monthly spending in the first stage is estimated at LD 499.7 in basic areas such as food and drink, hosting, entertainment, gas, electricity and fuel, healthcare, family assistance, transport and logistics. However, food and drink constituted the main area of spending, amounting to LD 212 (42.4%), transport and logistics LD 97.5 (19.5%), hosting and entertainment LD 65.8 (13.2%),

fuel and electricity LD 49.6 (9.9%), the health care LD 48.3 (9.7%) and family assistance LD 26.4 (5.3%), as shown in Table 5.28.

Table 5.28: Family Expenditure per Month in the First Stage

Expenditure Item	Total per month (LD)	Percentage of Total expenditure
Food and drink	212	42.4
Transport	97.5	19.5
Fuel and lighting	49.6	9.9
Health care	48.3	9.7
Family helping	26.4	5.3
Others	65.8	13.2
Total	499.7	100

Source: - Collected and calculated from the questionnaire

However, as for the second stage, total spending is estimated at LD 516.6. Food and drink cost LD 177.4 (34.3%), with LD 95.5 for hosting and entertainment (18.4%), LD 68.6 for healthcare (13.3%), LD 28.2 for family assistance (5.5%) and for fuel and electricity LD 26.2 (5.1%), as shown in Table 5.29.

Table 5.29: Family Expenditure per Month in the Second Stage

Expenditure Item	Total per month (LD)	Percentage of Total expenditure
Food and drink	177.4	34.3
Transport	121	23.4
Fuel and lighting	26.6	5.1
Health care	68.6	13.3
Family helping	28.2	5.5
Others	94.8	18.4
Total	516.6	100

Source: - Collected and calculated from the questionnaire

5.14. The Farm Economics

5.14.1. Costs of Production

These usually relate to the costs incurred by farmers. These costs are shown in Table 5.30, which illustrates the costs of production per hectare of cereals and forage per farm.

Table 5.30: Costs per Hectare of production from Crops and Forage by LD 2002-2003

Item	Barley	Forage
Seeds	115.5	115.5
Tractor fuel	3	3
Chemical fertilizer	25	3
Harvest costs	150	150
Total	293.5	293.5

Source: - Collected and calculated from the questionnaire

From the above table 5.30, one hectare cost around LD 293.5 for barley and LD 293.5 for animal feed making a total cost of LD 587 for both cereals and forage.

Total costs for cereals and forage in the first stage farm was estimated at LD 792.45 and LD 469.6 respectively, compared to LD 733.75 and LD 498.95 in the second stage farm. This gives a total cost for barley of around LD 1,262.05 and for forage LD 1232.7 in the second stage farm as shown in table 5.31

Table 5.31: Cost of the Cultivated Area for Crop and Forage in the Farm by LD 2002-2003

Item	First stage farm			Second stage farm		
	Area (Hectares)	Cost per Hectare (LD)	Total Cost (LD)	Area (Hectares)	Cost per Hectare (LD)	Total Cost (LD)
Barley	2.7	293.5	792.45	2.5	293.5	733.75
Forage	1.6	293.5	469.9	1.7	293.5	498.95
Total	4.3	587	1262.05	4.2	293.5	1232.7

Source: - Collected and calculated from the questionnaire

Table 5.32 shows that the cost of fruit per hectare was around LD 600 for grapes, LD 300 for figs, LD 493.4 for palm dates and LD 30.4 for olives. For these costs, however, it must be pointed out that the fruit trees are distributed in an area in excess of one hectare shared among the different fruit trees, as shown in Table 5.33.

Table 5.32: Costs per Hectare of the Production of Fruits By LD 2002-2003

Item	Grape	Fig	Palm	Olive
Tractor fuel	3	3	3	3
Cleaning and pruning	72	72	72	-
Grassing	75	75	75	-
Collecting and packing	450	150	323.4	27.5
Total	600	300	493.4	30.4

Source: - Collected and calculated from the questionnaire

Table 5.33: Costs of the Cultivated Area for Fruit By LD 2002-2003

Item	First stage farm			Second stage farm		
	Area (Hectares)	Cost per (Hectares)	Total Cost (LD)	Area (Hectares)	Cost per (Hectares)	Total Cost (LD)
Grapes	1	600	600	1	600	600
Figs	1	300	300	1.2	300	360
Palms	1	493.4	493.4	1	493.4	493.4
Olives	9.8	30.4	297.92	9.6	30.4	291.84
Total	12.8	1423.8	1691.32	12.8	1423.8	1745.24

Source: - Collected and calculated from the questionnaire

The above Table 5.33 shows that the total cost of fruit trees was LD 1,691.32 and LD 1,745.24 in the first and second stage farms respectively. However, fig trees are cost prohibitive, and there were more of them in the second than the

first stage. Hence this explains the variation in cost in the two stages. The cost of vegetables per hectare is illustrated on Table 5.34 below.

Table 5.34: Costs per Hectare of the Production of Vegetables By LD 2002-2003

Item	Onions	Watermelons	Tomatoes
The seeds	210	210	150
The fuel of the tractor	3	3	3
The arboretum	20	-	20
Chemical fertilizer	25	25	25
Organic fertiliser	20	60	20
Transfer the arboretum	20	-	20
Collecting and packing	262	202	262
Total	560	500	500

Source: - Collected and calculated from the questionnaire

The real vegetable cost is estimated at around LD 1310 in the first stage farm compared to LD 2060 in the second stage farm, as shown in Table 5.35.

Table 5.35: Costs of the Cultivated Area for Vegetables By LD 2002-2003

Item	First stage farm			Second stage farm		
	Area (Hectares)	Cost per (Hectares)	Total Cost (LD)	Area (Hectares)	Cost per (Hectares)	Total Cost (LD)
Onions	1	560	560	1	560	560
Watermelons	1.5	500	750	2	500	1000
Tomatoes	-	-	-	1	500	500
Total	2.5	1060	1310	4	1560	2060

Source: - Collected and calculated from the questionnaire

5.14.2. Total Income of the Farm

This income is made up of the returns from the sales of plant and animal products prior to the subtraction of production costs. Hence, the total income for the first stage farm was 484.5 from cereals (barley), LD 3,426.2 from fruit, around LD 3,085.7 from vegetables and LD 1,257.1 from sheep and goats, giving a total of LD 8,253.5. In contrast, the total income of the second stage farm was LD 480 from cereals (barley) and forage, LD 4,497.2 from fruits, LD 3,029.8 from vegetables and around 1,877.5 from sheep and goats; totaling around LD 9,866.5.

5.14.3. Net Income of the Farm

Table 5.36 shows the total net income after the subtraction of the annual production costs.

Table 5.36: Total Income and Costs and Net Income

Item	First stage farm			Second stage farm		
	Total Income (LD)	Total Costs (LD)	Farm's net Income (LD)	Total Income (LD)	Total Costs (LD)	Farm's net Income (LD)
Crops and forage	484.5	1262.05	-777,55	480	1232.7	-752.7
Fruit	4426.2	1691.32	1734.88	4479.2	1745.24	2733.96
Vegetables	3085.7	1310	1795.7	3029.8	2060	969.8
Sheep and Goats	1257.1	1221.6	355	1877.5	1645.6	231.9
Total	8253.5	5484.97	3088.03	9866.5	6683.54	3182.96

Source:- Collected and calculated from the questionnaire

From the above Table 5.36, the net income of a single farm was around LD 3,088.03 in the first stage and around LD 3,182.96 in the second stage after the subtraction of costs. It is also clear that the net income in a second stage farm is in excess of the first stage farm. This could be due to many reasons, most importantly of which are variations in production, the number of planted tress where more trees exist in the second stage than in the first stage and also variations in the cultivated areas. Moreover, in the first stage farm the average income from vegetables gives a higher proportion of income compared to other products. In contrast the average income from fruit is higher compared to other products in the second stage, despite the fact that the area used is small and the fruit trees are fewer compared to the area allocated in the approved crop formation. However, the farmers mainly depend on the already existing trees with the partial cultivation of vegetables and a few fruit trees. This will greatly affect the cultivated land and will hamper any efforts for the ideal utilization of land.

5.15. The Main Agricultural Features of Wadi Al-Hai Project

5.15.1. The Age Structure of Farmers:

It can be said that farmers in the first or second stage all belong to the older generations. Around 47.5% belong to the age group 50-60 years in both stages. On the other hand those above 60 years of age represent around 25% and 38.5% of the total farmers in the first and second stages respectively, and the age group 30-40 years represents only 1.5% of the first stage and 7% of the second stage farmers compared to around 12.5% of the first stage and 3% of the second stage for the age group 40-50 years.

Table 5.37 (see Appendix C, figures 5.1,5.2) shows that the majority of both first and second stages farmers are over 40 years old (over the age of peak productivity), and therefore since the physical strength and agility of a farmer is a basic requirement of the farming process, then the age factor could be an important main reason behind the failure of farmers to make the most of the available farmlands provided to them. This is reflected in the continuous decrease in the cultivated land as well as the ever-decreasing production levels.

Table 5.37: Age Structure of the Farmers in the Project

The Age	First stage farm		Second stage farm	
	Frequency	Percentage %	Frequency	Percentage %
30-40 years	6	15	7	10.7
40-50 years	5	12.5	3	4.6
50-60 years	19	47.5	30	46.2
More than 60 years	10	25	25	38.5
Total	40	100	65	100

Source: - Collected and calculated from the questionnaire

5.15.2. Education:

Education is the ideal method for the mental, physical and social preparation of individuals to undertake their potential role in society in a more proactive way. However, as far as rural society is concerned, education is more likely to render

it better equipped to overcome illiteracy, which constitutes the main obstacle for rural development. The importance of education lies with the elimination of illiteracy and providing the farmers with basic education, as education tends to improve the skills and experience of the older generation, and therefore they will make better use of the technology and equipment at their disposal.

However, this study has found that most of the farmers especially the older generation have missed the opportunity for basic education. Around 75% of the first stage farmers and around 76.6% of the second stage farmers were illiterate. In contrast only 15% of the first stage and 15.4% of the second stage farmers were educated up to the elementary level. On the other hand, those who received education to the intermediate level constitute only 5% and 4.6% compared to 5% and 3.1% for the secondary level of the total farmers of the first and the second stages respectively, as shown on Table 5.38 (see Appendix C figures 5.3, 5.4).

Table 5.38: Education Level of the Farmers in the Project

Education level	First stage farm		Second stage farm	
	Frequency	Percentage %	Frequency	Percentage %
No education	30	75	50	76.9
Primary	6	15	10	15.4
Secondary	2	5	3	4.6
College	2	5	2	3.1
Total	40	100	65	100

Source: - Collected and calculated from the questionnaire

From the foregoing it is clear that the majority of the first and second stage farmers were illiterate and lacked basic education. This illiteracy factor may represent the main obstacle in the process of the farmers understanding and communicating information, which is reflected in the smaller cultivated areas and subsequent low productivity.

5.15.3. Devotion to Agricultural Work:

The questionnaire data indicated that only around 35% of the first stage farmers were engaged in farming as a full time job, compared to 65% who considered farming as a part-time job. Likewise only 40% of the second stage farmers considered farming as full time and 60% as part time. It is obvious from Table 5.39 (see Appendix C, figures 5.5, 5.6) that the majority of farmers of both stages were not fully engaged in farming. They were also engaged with other activities outside the farm. However, given the advanced age of the majority of farmers, this could be due to the fact that the majority of the farmers were not physically capable of working full time on the farm, or otherwise that they may have lacked the necessary equipment for doing the job. Yet, as a result of this double engagement of the majority of farmers, the whole farming process is affected, which is reflected in the ever-diminishing areas cultivated as well as the deterioration in the socio-economic conditions of the farmers. However, for the land to be used in a suitable way to generate higher incomes to be used for further investment in agriculture, this implies that farmers should be fully engaged in the farming process provided that all the necessary equipment and materials are available.

Table 5.39: Devotion to Agricultural Work in the Project

Devotion	First stage farm		Second stage farm	
	Frequency	Percentage %	Frequency	Percentage %
yes	19	47.5	50	76.9
No	21	52.5	15	23.1
Total	40	100	65	100

Source: - Collected and calculated from the questionnaire

5.15.4. Agricultural Experience

It can be maintained that the project farmers have developed considerable farming experience. For example, 47.5% of the first stage and 44.6% of the second stage farmers have more than 21 years each of farming experience. In contrast farmers with 10-20 years of farming experience represent only 27.5% of first stage farmers and 30.8% of the second stage, whereas those who have 5-10 years farming experience represent only 15% of the first stage farmers and 24.6% of the second stage, as shown in Table 5.40 (see Appendix C, figures 5.7, 5.8).

Table 5.40: Agricultural Experience of the Farmers in the Project

Experience (Years)	First stage farm		Second stage farm	
	Frequency	Percentage %	Frequency	Percentage %
5-10 years	10	25	16	24.6
10-20 years	11	27.5	20	30.8
More than 21 years	19	47.5	29	44.6
Total	40	100	65	100

Source: - Collected and calculated from the questionnaire

However, it is evident that while farming experience is vital and indispensable for increasing farm productivity, the experience of the farmers at the Wadi-Al-Hai project was very limited with respect to some traditional processes in agriculture. For this reason farmers have been ineffective in boosting production and in using the available land.

5.15.5. Soil Quality:

Most of the land in theWadi Al-Hai project is sandy-clay. This type of soil represents around 72.5% of the total land in the first stage and around 53% in the second stage. In contrast clay represents around 20% in the first stage farms and around 35.4% in the second stage, whereas sandy soil represents 7.5% of the total area in the first stage and only 10.8% in the second stage, as shown in Table 5.41 (see Appendix C, figures 5.9, 5.10).

Table 5.41: Soil Quality in the Project

Soil type	First stage farm		Second stage farm	
	Frequency	Percentage %	Frequency	Percentage %
Sandy	3	7.5	7	10.8
Clay	8	20	23	35.4
Sandy and clay	29	72.5	35	53.8
Total	40	100	65	100

Source: - Collected and calculated from the questionnaire

This data suggests that most of the soil involved in the two stages is made up of sandy-clay. Therefore, given the many complications associated with this type of soil that restrict farming processes, which has affected productivity as well as the wide use of the land.

5.15.6. Irrigation Water:

The availability of irrigation water is crucial to farming regarding the area used as well as the crop formation. However, this study shows that water was available for the majority of farms. 72% of the first stage and 53.8% of the second stage farms enjoyed adequate water sources, whereas only 20% of the first stage farms and around 35.4% of the second stage suffered from water shortages. In contrast 7.5% of the first stage farms and 10.8% of the second stage lacked suitable water sources, as shown in Table 5.42 (see Appendix C, figures 5.11, 5.12).

Table 5.42: Adequacy of Irrigation Water in the Project

Adequacy of irrigation water	First stage farm		Second stage farm	
	Frequency	Percentage %	Frequency	Percentage %
Adequate	3	7.5	7	10.8
Barely adequate	8	20	23	35.4
Inadequate	29	72.5	35	53.8
Total	40	100	65	100

Source: - Collected and calculated from the questionnaire

However, the figures shown in the above table relate to the irrigated areas. In relation to the two stages of rainwater was meagre during the season 2002-2003, resulting in drought and the subsequent withering of most trees across the cultivated area.

5.16. Desires and Ambitions of the Farmers' Sons for the Future

It is a known fact that the farmers currently in charge belong to the older generations, as the average age in the project is over 40 years. As a matter of fact, sooner or later this generation will perish, giving way to future generations. The table below summarises the future aspirations of the farmers' sons.

Table 5.43: Desires and Ambitions of Farmers' Sons in the project For the Future

Occupation	Frequency	Percentage %
Teacher	45	42.9
Engineer	15	14.3
Doctor	25	23.8
Framer	2	1.9
Administrator	8	7.6
Others	10	9.5
Total	105	100

Source: - Collected and accounted from the questionnaire

Table 5.43 suggests that the majority of the sons in the project would prefer the professions, giving priority to teaching (42.9%), medicine (23.8%), and engineering (14.3%). These professions represent 81% of the total choices, whereas administration and the farming jobs represent (7.6%) and (1.9%) respectively of the choices of the respondents.

However, given the desires and ambitions of the farmers' sons it could be concluded that the future of the project might be bleak and uncertain, if the sons'dreams come true. This implies that the younger generations will be doing other jobs at the expense of the farming profession, hence leaving the farms for the elderly, women and hired labour.

5.17. Conclusion

The agricultural activities in the Wadi-Al-Hai project are divided into two stages i.e. the first and second stages. Both stages produce crops, fruits, and vegetables besides animal products such as meat and milk. The crops mainly include cereals, which represent cash crops for farmers despite the fact that the production is mainly dependent on rains. Cereals include barley, forage and hay as by-products used as animal feed. Fruit products include figs, grapes, dates and olives. The production of fruits is mainly intended to meet local demand and any surplus is distributed in markets all over the country. The vegetables include onions, watermelons and tomatoes. The productivity of vegetables is low, but nonetheless can be improved by improving the soil by adding the right amounts and types of fertilizers.

The agreed crop formation plan in the project is based on fruits as the main product and vegetables as secondary product. However, one of the main reasons for low productivity is that farmers do not comply with the agreed crop formation, in addition to their poor knowledge of modern agricultural techniques such as ways of combating pests.

Besides routine agricultural activities, animal farming is becoming significant given the huge incomes it generates for farmers. Hence most farmers of the project are becoming increasingly engaged in mixed farming activities, with goats and sheep being the main animals involved supplying the farmers with meat and milk.

The products are mainly marketed outside the project in the neighbouring towns, and yet some of the products are marketed within the project. The

importance of the outside markets stems from the fact that these markets represent a rendezvous for farmers, brokers and middlemen where the process of wholesale saves the farmers time and effort, besides selling their products at reasonable prices.

To assist farmers undertake their duties in a proper and more efficient way cooperatives have been established. The main objective of these cooperatives has been to provide the most necessary services such as equipment, fertilizers, and pesticides. However, a survey of the farmers has indicated that the majority of them believe that they have not been provided with the required services. This can be attributed to the shortages in the finances of these cooperatives as well as the scarcity of equipment and materials.

The main problem facing the project is that the majority of the farmers are illiterate, which therefore makes it difficult for the authorities to extend agricultural information and knowledge to these farmers, which then directly affects productivity. Another problem is that the majority of farmers i.e. in excess of 60% on average are engaged in other activities outside the farm given the advanced age of 50+ of most of the farmers. Moreover in most cases the soil is sandy clay with poor productivity. Also in the past two years the meagre amounts of rain have resulted in drought causing the withering of trees and crops.

CHAPTER SIX

MODEL SPECIFICATION AND ECONOMETRIC ESTIMATION

6.1: Introduction

Having already dealt with the statistical properties of our data in the previous chapter, here we aim to formulate a simple yet practical model for the purpose of econometric estimation. The model is deemed appropriate, as the estimated model will enable us to identify the extent of contribution of the relevant explanatory variables. Moreover, the estimated parameters/elasticities can be used as good policy indicators in evaluating the true costs and benefits of the project. In effect, some of our estimated parameters can be interpreted as shadow prices within the context of CBA; which exhibit the extent of willingness to pay by of both the recipients and the providers of the service, hence being of significant use to policy-makers.

In part 2 we examine a cross-section analysis of our proposed model, making references to typical potential problems under such an analysis. Part 3 contains the estimated econometric findings, and associated issues vis-à-vis post estimation procedures. Finally, this chapter ends with conclusions and a summary of the main points.

6.2: The Econometric Model and Diagnostic Procedures

As an appropriate starting point, one needs to define and construct a mathematical or econometric model for the purpose of estimation. Here the aim is to offer a simple model which is easier to understand, communicate and test empirically with the data. However, an oversimplified model may fail to explain the complexity of the real world. In the model we are about to present, we do understand that political factors play important roles in determining land use. However, since most political/social indicators may not be easily quantified, we attempt, therefore, to measure their contributions in terms of intercept term or of error of in the model. Based on the

variables introduced in part 6.2, our econometric model is based on a linear/log-linear form which may be shown as:

$$Y_i = \alpha + \beta X_i + \gamma Z_i + u_i \qquad i= 1, 2, 3,\ldots,105 \qquad (6.1)$$

In expression (6.1), Y, the land usage share is the dependent variable; Xs are the explanatory variables defining the characteristics of the farmers (education, experience, age and devotion), and Zs are independent variables defining external factors/inputs (water, fertilisers, soil, etc.). These two sets of independent variables jointly determine the dependent variable. The coefficients/elasticities, shown as β, γ, represent the respective size of the contributions made by respective right-hand side variables. The intercept term is shown as α. Finally, the term u represents a classical white-noise disturbance term with zero mean and fixed variance; this is the error term which satisfies white-noise conditions, so that $u_i \sim \text{NID}(0, \sigma^2)$.

In building this classical model, special reference must be made to the underlying assumptions in relation to the independent variables and u. The right-hand side variables are fully independent, so that the direction of causality is from X and Z to Y and not the other way around. Moreover, these independent variables have no strong correlation with one another; nor do they have any association with the error term, u. Finally, in relation to u, there is no correlation between successive values of the error term, making it possible for the u term to enjoy a zero mean and fixed variance. This assumption is referred to as *homoskedasticity*. Using the expected value, E, these assumptions can be shown in the following forms:

$$E(X_i Z_i) = 0 \qquad (6.2)$$

$$E(X_i \mid Z_i u_i) = 0 \quad (6.3)$$

$$E(u_i u_j) = 0 \quad (6.4)$$

So, the above model will yield unbiased, efficient estimators, provided the above assumptions are to hold. The breakdown of any of these assumptions will reduce the property of unbiasedness of the estimated coefficients and hence reduce the degree of precision of these estimators in predicting the true contributions of Xs and Zs in determining Y. In short, the breakdown of assumption 6.2 will lead to the problem of *multicollinearity*, generally believed to be serious when simple correlation coefficients amongst Xs and Zs exceed the multiple coefficient of determination. Moreover, the breakdown of assumption 6.3 and 6.4 will lead to the so-called *heteroskedasticity* problem, where the variance of the error term may vary significantly from observation to observation. Since in most cases such problems tend to occur in a multi-variate setting, we need to explore the underlying issues relating to the detection and elimination of these problems once they have occurred.

6.2.1: Multicollinearity: Methods and Applications

The concept of multicollinearity was first introduced and elaborated by Frisch (1934), when he referred to a situation where the variables dealt with were subject to two or more relations. In effect, he had assumed all the explanatory variables to be subject to error, and hence the problem was to estimate the different linear combinations amongst the true variables. As discussed by Maddala (2003), multicollinearity or high inter-correlations amongst explanatory variables need not necessarily be a problem. However, if it is proven that the extent of relationships amongst explanatory variables is acute, one needs to re-specify the model to improve the degree of precision of the estimated coefficients.

The degree of acuteness is normally measured by examining the estimated standard errors of the parameters. If they are exceptionally high, yielding statistically insignificant estimators, this may be regarded as a symptom of multicollinearity. However, high values of partial correlations need not necessarily imply high standard errors, and conversely, even low values of partial correlations can produce high standard errors. In short, detection of multicollinearity merely through partial correlations is not sufficient to lead us to any concrete verdict on the presence or absence of multicollinearity. In the case of models with more than two explanatory variables, what we have to consider are multiple correlations of each of the explanatory variables with the other explanatory variables.

There are several simple rules and methods suggested in the literature in detecting multicollinearity, when it is proven to be a serious problem. For example, Klein (1962) regards multicollinearity as a problem only if the coefficient of multiple correlation, R^2, falls short of any partial correlation coefficients amongst explanatory variables, r^2. This method appears to be simple and applicable, but fails to be sufficient in the detection of multicollinearity, as it does not consider the estimated standard errors as the basis of detection. By the same token, the other two common techniques, namely the *variance inflation factor* (VIF) and the *condition number* (CN), though attempting to relate the estimated coefficients variances to explanatory variables multiple correlations, they fail to relate to other factors giving rise to high standard errors. Model misspecification, sampling inadequacy, and incorrect parameterisation are some other problems leading to potentially high standard errors, rather than the mere examination of multiple correlation coefficients. Grilliches et al (1962), Smith (1980) and Maddala (2003), amongst many, are the authors who have made attempts at detecting multicollinearity in cases where Klein's rule has rejected

serious multicollinearity. In short, the mere examination of the partial/multiple correlations amongst explanatory variables does not mean that we have no problems with inference.

Once a case of serious multicollinearity has been detected, it must be eliminated, as multicollinearity leads to incorrect and imprecise estimation of coefficients. There is no single solution here. Model re-specification, including dropping or re-parameterisation of variables is highly recommended as the first and most important solution to the problem. Improvement in data and re-sampling may in most cases prove to be successful in the removal of multicollinearity. Finally, another solution that is often suggested for tackling the multicollinearity problem is the application of *principal component* regression, which is practical and simple to use. Although being useful in the determination of the final number of independent variables, this method lacks economic theory as it is assumed that all explanatory variables be treated the same, and are given in a *k* set of linear functions.

6.2.2: Heteroskedasticity: Detection and Elimination

As mentioned earlier, one of the assumptions of the classical linear model is that the errors, u_i, in the regression equation have a common variance σ^2. This phenomenon is referred to as *homoskedasticity*. After conducting any OLS estimation, one needs to test for the presence of homoskedasticity. How can we trace heteroskedasticity? What if homoskedasticity fails to be present? Would this affect the degree of precision and the unbiased properties of our estimators? The answer to the latter question is that the estimators fail to be good predictors when homoskedasticity is absent. The answer to the former question is that heteroskedastic errors tend to exhibit explosive variances as the value of X increases. This is to say that

assumption (6.3) will be violated. The problem of heteroskedasticity is sometimes tackled by estimating the regression in a non-linear or a log-linear form. However, in most cases, different types of treatment are required to eliminate the problem.

Several tests have been recommended in detecting for heteroskedasticity. Firstly, the Reset test suggested by Anscombe (1961), and modified by Ramsey (1969), involves regressing the estimated errors on different powers of Y and testing whether or not the estimated coefficients are significant. Naturally, the null hypothesis is that the estimated coefficient is not significantly different from zero, hence rejecting heteroskedasticity. For example, in a simple model, $y_i = bX_i + u_i$, one attempts to see whether using y or X would yield similar results. In this case, one needs to run a regression of the form

$$\varepsilon_i = m_0 + m_1 X_i + m_2 X_i^2 + m_3 X_i^3 \qquad (6.5)$$

Where ε is the estimated errors, and m_i represents the coefficients of the explanatory variables; giving the null hypothesis as $m_i = 0$.

Secondly, the test suggested by White (1980) involves regressing the squared estimated errors on all the explanatory variables, and on their squares and cross products. In this case, depending on the number of explanatory variables, there may be many different forms of the estimated regressions. However, given the above simple expression, one of the forms of such regressions may be shown as:

$$\varepsilon_i = n_0 + n_1 X_i + n_2 X_i^2 \qquad (6.6)$$

Again, the null hypothesis ($n_i = 0$) needs to be verified in order to assure that there is no heteroskedasticity.

Thirdly, the Glejser (1969) test is based on estimating regressions of the absolute values of the error on different forms of X variables. Based on the simple model shown above, one form of such approach may be shown as:

$$|\varepsilon_i| = g_0 + g_1 X_i^{0.5} \qquad (6.7)$$

Once again, the estimated coefficients of X must be significantly not different from zero to verify the absence of heteroskedasticity.

Fourthly, there is a rather simple but effective method of testing for heteroskedasticity when a structural break has been identified as a main source of the problem. In this case, as suggested by Goldfeld-Qunadt (1972), we split the observations into two groups, corresponding to pre and post break, and fit separate regressions for each and then apply the F-test to test the equality of error variances. The case for homoskedasticity will be rejected once it is shown that the calculated F ratio has exceeded the F-distribution at the 1% level.

Finally, when the number of observations is large, one can use the *likelihood ratio* test, by dividing the estimated residuals into *k* groups with n observations in the *i*th group. Then estimate the variance of each group, σ_i^2, and the variance of the entire sample, σ^2. If one is to estimate the term $\lambda = \Pi (\sigma_i)^n i / \sigma^n$, then the log-likelihood term, shown as LR = $-2\text{Ln}(\lambda)$ will possess a χ^2 distribution with *k*-1 degrees of freedom. If there is only one explanatory variable in the equation, the ordering of the residuals can be based on the absolute magnitude of this variable. However, if there are two or more explanatory variables, then the predicted value of Y can be used. For example, given the above simple model, on the basis of 105 observations, and two unequal groups of 40 and 65 observations, let us assume that we have found the following variances: $\sigma_1 = 0.50$, $\sigma_2 = 0.25$, $\sigma = 0.4$. These estimated variances yield

the value of -63 for the likelihood ratio. The absolute value of our LR is, therefore, much larger than the value of the $\chi 2$-distribution with 1 degree of freedom and at the 1% significance level (15.3), hence suggesting a significant difference between the two error variances. This finding suggests that there is heteroskedasticity in our errors, which have to be corrected.

Once heteroskedasticity has been detected, the next question is how to remove this problem. In order to find an answer to this question, one must consider the potential consequences of heteroskedasticity for the OLS estimators. As discussed earlier, under heteroskedasticity the least squares estimators remain unbiased but inefficient, meaning that the estimated variances are biased and thus invalidate the tests of significance. To demonstrate this, let us consider a simple model in the form:

$y_i = \beta x_i + u_i$ where $E(u_i)^2 = \sigma_i^2$

The least squares estimator of β, here shown as b, is given by:

$b = (\Sigma xy / \Sigma x^2) = \beta + (\Sigma xu / \Sigma x^2)$

Under homoskedasticity, as the expected values of u and Σxu are zero, then the expected value of b would equate β, and thus b is unbiased. However, given that the variance of the errors is non-constant, the variance of the estimator can be shown as $V(b) = (\Sigma x \sigma_i^2) / (\Sigma x^2)$ where $\sigma_i^2 = \sigma^2 \rho_i^2$, and ρ being known variances of x. In short, ρ is a ratio of the heteroskedastic error to homoskedastic error, σ_i / σ. Since ρ is known, it can be used as a deflator in correcting for heteroskedasticity.

Considering the above, by dividing our observations by ρ, we will automatically correct our problem. Dividing our model by ρ we will get:

$y_i^* = \beta x_i^* + u_i^*$

where $y_i^* = y_i / \rho_i$, $x_i^* = x_i / \rho_i$, and $u_i^* = u_i / \rho_i$.

Note that u_i^* has a fixed variance. Since we are weighting or deflating the *i*th observation by ρ_i, the OLS estimation is referred to as weighted least squares (WLS). The estimated coefficient β is now both unbiased and efficient. In short, the WLS estimators are derived under homoskedasticity.

The analysis above shows that no matter what technique is used in detecting heteroskedasticity, one needs to calculate a suitable deflator or weight such as z, as shown above. This weight will enable us to convert our OLS into WLS, where the latter estimators are free from heteroskedasticity. One should note that in the case of the likelihood ratio test, one ends up with several weights depending on the number of sub-groups applied. Finally, sometimes it is possible to remove heteroskedastic errors without finding any weights/deflators, but merely through converting the simple linear model into a log-linear or a suitable non-linear form.

6.3: Econometric Application and the Evaluation of Findings

Having constructed our linear model and identified the appropriate procedures regarding possible problems arising from the use of multi-variate models, we are now in a position to apply the data to our model, given as expression (6.1). After a careful consideration of the data and running some basic tests, it was realised some variables could be merged into one. This was done in consideration with the possible weights, which may be attached to different variables. All the input variables (Zs) were added together, having allowed more weights for "water". Furthermore, the farmer's attributes, Xs, were merged together with appropriate weights attached to "devotion" and "experience". This way, any chance of serious multicollinearity amongst so many variables has been reduced. Moreover, the reduction of variables will help to improve the degrees of freedom of our estimation. As a first step, the

OLS is applied to our data, and the estimated results examined. Table 6.1 shows the estimated OLS findings. From this table it is clear that all the estimators have turned out to be statistically significant at the 1% level, and have all turned out positive, indicating that water access, fertilisers, soil, availability of inputs, and education, experience, age, and devotion have direct positive impact on land use. The value of R^2 is just over 0.68, indicating that up to 68% of variations in the dependent variable is explained by our independent variables. This also means that there is still 30% of variations in Y not being explained by these variables. Finally, the F-statistic of 112.5 is highly significant, indicating the goodness of the fit of our estimated model.

TABLE 6.1: Estimated Expression (6.1) using OLS

Variable	Coefficient	t-statistic	Prob.
α	4.8224	16.9830	0.0000
X	0.1738	2.4846	0.0145
Z	0.5523	9.7709	0.0000
$R^2 = 0.688$	SER = 0.823	F-stat = 112.6 (0.0000)	

Despite these somewhat pleasing results, there may still exist multicollinearity and heteroskedasticity, which need to be detected and remedied. First, we consider a test for the presence of multicollinearity. As explained earlier in this chapter, in the case where the estimated standard errors of the estimators turned out to be low, one needs to examine the partial as well as the multiple correlation coefficients amongst the explanatory variables. If in any case, these partial or multiple correlation coefficients turned out to be greater than the value of the R^2 shown in Table 6.1, then the explanatory variable(s) responsible for multicollinearity will be dropped out of our model. In so doing, we have estimated the partial correlation and multiple correlation between X and Z, as being 0.262 and 0.068, respectively. The latter

value is much lower than the estimated R^2 shown in Table 6.1, and hence indicating that there is no serious multicollinearity amongst our explanatory variables.

Now we proceed with the test for heteroskedasticity, using the techniques discussed earlier. Here, we apply the tests that are relevant to our case: large sample size with four explanatory variables. The Goldfeld-Quandt and the likelihood ratio tests appear to be highly appropriate here. Moreover, we do apply the White's test to check if any combinations of our explanatory variables may exhibit high correlation with the estimated squared residuals. Prior to the application of these tests, it is advisable, though, to consider a visual examination of the relationship between the estimated residuals and the independent variable.

We begin our testing with the application of White's test, when attempting to identify any possible correlation between the squared errors and the explanatory variables. To conduct such a test, we should examine several combinations in which these explanatory variables can be associated with the squared residuals. These have been depicted in Table 6.2 with their respective estimated R^2. As the values of R^2 in all cases are very small, we have therefore not shown the estimated standard errors of the respective coefficients. As can be seen from Table 6.2, no regression exhibits a large enough R^2 to indicate any serious correlation between the estimated residuals and the independent variables. So, according to White's test, the estimated errors exhibit no heteroskedasticity. In other words, the White's test detects no heteroskedastic errors.

TABLE 6.2: Findings From The White's Test (u^2: dependent variable)

MODEL	Variables Used	R^2
1	X, X^2, X^3	0.124
2	Z, Z^2, Z^3	0.132
3	XZ	0.065
4	$X, X^2, X^3, Z, Z^2, Z^3, XZ$	0.175

Our second test is based on the Goldfeld-Quandt test of heteroskedasticity. We examined the data carefully and noticed that for the first 50 observations the values of Y and X are relatively smaller than those of the remaining observations. For this reason, our two sample sizes are identified as $n_1 = 50$, and $n_2 = 55$. We, therefore, ran two separate regressions on our linear model for these two samples, and estimated the two error variances, σ_1^2 and σ_2^2, which turned out to be 0.34 and 0.82, respectively. The estimated F ratio, therefore, is given by dividing 0.82 by 0.34, which means that F = 2.41, which is smaller than the value of F-distribution at the 1% level of significance with (n-k) and (n-1) degrees of freedom. This suggests that we cannot reject the null hypothesis that the errors are homoskedastic. As the Goldfeld-Quandt test suggests, therefore, there appears to be no sign of heteroskedasticity.

As our final test for heteroskedasticity, we embark on the use of the likelihood ratio test. Based on the same two samples used for the Goldfeld-Quandt test, having already calculated the two samples error variances (0.34 and 0.82), and the full sample error variance as 0.67 calculated from Table 6.1, we are now able to calculate the likelihood ratio and hence the term $LR = -2\ln(\lambda)$. On the basis of this information, in consideration with what was said in part 5.3, the absolute value of LR is 23.2, which is larger than the χ^2 distribution, at the 1% level, being 11.66,

indicating that there appears to be some degrees of heteroskedasticity. So, as other tests have failed to detect any sign of heteroskedasticity, here the likelihood ratio test indicates that the case of homoskedastic errors is refuted.

As mentioned earlier, the likelihood ratio test is the most appropriate test for our case study, as it is designed for multivariate models with large sample size. Here we need to correct our data in order to remove heteroskedastic errors. Since we have divided the sample into two sub-groups, the estimated standard errors of each group will be used as weights in deflating the data. Once the data is deflated, we apply the OLS to our new data, and the new estimates will be referred to as weighted least squares (WLS) estimates, as explained earlier. So, our final, reliable estimates will be those based on WLS rather than OLS. Table 6.3 gives the estimated coefficients of WLS. For the means of comparison, we have also shown the OLS estimates (from Table 5.1) in this table. A careful examination of these results indicate that the WLS yields a much lower SER, compared to that of the OLS. Likewise, all the estimates are statistically significant at the 1% level, as shown by their respective estimated standard errors (shown in brackets). Although there appear to be some similarities in the size of these estimated coefficients from the two methods, in all cases, the OLS tend to over-estimate the true values of these coefficients. One must note that the estimates of R^2 have not been shown in this table, as the WLS is a non-linear approximated model of OLS, and hence R^2 does not represent a measure of goodness of fit in this case. In this case, instead, an appropriate measure of fitness should be considered as the standard error of regression (SER), as shown in this table.

As a final note here, one must bear in mind that though there are differences in these two methods of estimation, in all cases, with the exception of the constant term, these differences are not statistically significant.

TABLE 6.3: Comparison of OLS and WLS Estimates

Variable	OLS	WLS	Difference
α	4.8224	3.9332	-0.8892*
	(0.285)	(0.065)	(0.175)
X	0.1738	0.2015	0.0277
	(0.069)	(0.041)	(0.054)
Z	0.5523	0.5798	-0.0275
	(0.056)	(0.045)	(0.049)
SER	0.823	0.801	0.022

* Statistically significant at the 1% level.

A possible alternative, as argued elsewhere, may be to convert the linear model into non-linear, provided that the dependent variable exhibits non-linear movements. In effect, over a large part of our sample, as can be seen in Figure 6.1, the dependent variable grows exponentially, indicating that the use of a linear model can only be an approximation but not necessarily a perfect one.

This is to say, that expression 6.1 should have been, alternatively, presented as:

$$\text{Log}\,(Y_i) = \log(\alpha) + \beta \log(X_i) + \gamma \log(Z_i) + u_i \qquad (6.8)$$

In order to estimate expression (6.8), all we need to do is to convert all the variables into log-natural and then apply the OLS. It should, however, be noted that the estimated coefficients are no longer simple multipliers, but they are referred to as the

estimated elasticities relating X and Z to Y. The estimated expression (6.8) is shown in Table 5.4. As can be seen, all the estimators have turned out to be highly statistically significant, and R^2 is estimated at 0.66, indicating that just over 65% of variations in LY is determined by all X and Z jointly. The estimated partial elasticities are less than unity but highly significant. As this table suggests, a 10% increase in farmer's attributes will lead to a 1.3% increase in land use. On the other hand, a 10% increase in inputs, all other things being equal, will lead to a 1.7% increase in land use. On the whole, in the long run, when all factors can be assumed to vary, then a 10% increase in both factors will lead to a total increase in land use of as much as 3%.

TABLE 6.4: Estimated Semi-log Model using OLS

Variable	Coefficient	t-statistic	Prob.
α	1.6360	29.520	0.0000
X	0.1311	3.156	0.0021
Z	0.1710	8.443	0.0000
$R^2 = 0.661$	SER = 0.098	F-stat = 93.7	(0.0000)

6.3. Conclusion

This chapter is based on an attempt to develop and estimate an econometric model for land use on the basis of data collected from the questionnaire responses. The aim is to estimate, using a simple linear/log-linear model, the marginal contributions made by each explanatory variable in the model. In so doing, a simple but practical linear model was first developed. The estimated model using OLS was offered and their predictability was investigated. At best, only up to 70% of variations in the dependent variable were to be explained by our explanatory variables, meaning that there still remains a significant size of variations in the dependent variable which was

unexplained. For this reason, the remainder of this section was dedicated to discovering the nature of the error generated by the OLS.

The estimated model was subjected to test for multicollinearity. In so doing, we went beyond the rule of thumb suggested by Klein. The examination of both the partial and multiple correlations showed that there is no sign of multicollinearity present in our estimated model. Moreover, the examination of the standard errors of the estimated coefficients and the overall stability statistic (F-statistic) all reveal that the estimated model is free from any serious multicollinearity.

The model as it stood was also subjected to test for heteroskedasticity, using different techniques. It was then discovered, using the log-likelihood ratio, that there may exist some degrees of non-homoskedastic error. Having treated for heteroskedasticity, we then compared and contrasted the estimated results. The overall picture showed that the estimated coefficients tend to be highly significant, and relatively large in magnitude.

On the whole, it should be noted that the estimated findings are indicative of a rather stable, robust log-linear model. As explained earlier, a significant proportion of variations in the dependent variable still remains unexplained, indicating that some fundamental, yet non-quantified, political/social elements need to be included in the model.

CHAPTER SEVEN

SUMMARY AND CONCLUSION

7.1: Summary of the Main Findings

This study is aimed at understanding the performance of the agricultural sector in the case study project, through relevant plans involving the use of agricultural resources in order to reach an ideal agricultural policy that will achieve economic independence regarding the natural, economic and human resources available to the project. The study has also discussed issues pertaining to the economics of agricultural resources, crop formation, and incomes from both plant and animal production and the family spending of this income as well as the effects of some socio-economic factors on the agricultural exploited area in the project.

The first chapter included an introduction to the study highlighting the importance of the study, given the fact that it represents one of the very few studies that have, so far, addressed the effects of socio-economic factors on agricultural exploited area. The importance of this study also stems from the fact that it draws the attention of the authorities and provides them with the required information with respect to the effects of these factors. Furhemore, taking these factors into consideration will be likely to help in achieving the projects' objectives. The first chapter also explained the aims of the study, the research methods used, and a review of previous related studies in Libya and neighbouring countries.

The second chapter discussed the role of agriculture in economic development, including definitions of the later. Also the significance of both agricultural and economic development came under scrutiny. This chapter also included a review of agricultural development in third world countries, besides some of the theories and concepts of

economic development and the potential difficulties that may hamper this development in developing countries.

Most economic analysts consider agriculture the principle, if not the only, source for economic prosperity. For example, Adam Smith (1776) perceived agriculture as having the edge over manufacture because it incorporates land and labour, which are the two major economic powers. Hence, most scholars deem agriculture as the shortest way to achieve self sufficiency in favour of the well being of the population.

However, agricultural planning is one of the means that leads to economic independence through the implementation of modern technology. Therefore, through proper agricultural development plans, farmers can increase their income. Nonetheless, in order to secure the success of these plans, coordination among relevant government institutions becomes an urgent matter. Moreover, information related to human resources and the prevailing social values are important elements for proper agricultural planning. Flexibility in planing is also, another element of success, since it allows a regular review of the plan to cope with changing circumstances.

In developing countries agricultural development constitutes the core of economic planning. Besides being the source of food, agricultural development is likely to generate huge revenues that can be used for the development of other economic sectors. Therefore, should agricultural planning be successful in developing countries, it would tend to improve people's living standards, and would generate revenues to develop other sectors such as manufacturing and would modernise rural areas to catch up with the urban areas.

However, the complexity of the nature of economic development provokes major controversy among scholars. For example some scholars, such as Mosher (1964) ,perceive the process of agricultural development simply as the productive activities of people cultivating land and tending livestock. Southworth (1968), on the other hand, believes that a fully developed theory of agricultural development should take into consideration the interaction between agricultural and non-agricultural sectors.

In any case agricultural development can be measured by the output per worker, whereby the higher this output the more advanced and successful is agricultural development in the country. For example, in India output is almost one-fifteenth of that of the US, and yet very few developing countries show outputs as high as one-fifth of the US.

In developing countries, Libya being no exception, numerous obstacles hamper agricultural development. These obstacles may be economic, social or technical. The most important of these obstacles is the inadequate training of farmers and their failure to cope with modern technology due to widespread illiteracy.

Agricultural development, however, can receive a great boost in developing countries through the reclamation, reform and official allocation of land provided the above mentioned obstacles are tackled.

Chapter three examined the development of Libyan agriculture during the period 1972-1985. This period was associated with the revolutionary plan, which aimed at increasing

national production besides rendering the economy more diversified and independent of oil and the foreign markets. However, agricultural development during this period suffered from the shortages of skilled labour and inefficient administration.

The strategies adopted during that period were largely inadequate, as indicated by the sustained importation of cereals and meat. But, nonetheless, polices pertaining to land settlement and rural development have met with some success in reducing the gap between urban and rural areas as well as in improving the standard of living for the people.

Given the fact that most of Libya is an absolutely barren desert, agricultural activities are confined to a narrow strip along the Mediterranean Coast, where variable and unpredictable climatic conditions prevail.

In the aftermath of the discovery oil in the early fifties agriculture became less important with regard to its contribution to the GDP, and yet 65% of the population, representing the inhabitants of rural areas, depended on agriculture as a source of subsistence.

However, agricultural development in Libya has suffered many setbacks, one of which is its failure to cope with the demands of the rapidly growing population. Nonetheless, despite the growing population, one of the main problems that has hampered agricultural productivity is shortages in the skilled workforce.

Agricultural development has always been a top priority in economic planning, as policy makers and planners tend to provide the agricultural sector with all the necessary facilities and services that would be likely help to improve its performance and augment its contribution to the national economy. But due to the high purchasing power of the public, this sector has failed to meet the increasing demand for its products.

Following the Revolution of the First of September in 1969, planners and policymakers have realised the importance of agriculture to the national economy. Hence, the core of their socio-economic policies has been to render the economy less oil-dependent by diversifying economic resources. Therefore, to reach that end, the agricultural sector has received more attention in order to achieve self-sufficiency, and to cut down imports of agricultural products. Consequently, agriculture has featured as the backbone of all economic transformation plans spanning the period 1973-1985. However, following the 1986 drop in international oil prices funding for the agricultural sector has deteriorated.

In order to revolutionise agricultural activities, the government has tended to establish agricultural co-operatives, but despite the huge subsidies provided to these co-operatives, they failed to achieve their goals. This failure could be attributed to many factors. Such as the lack of skilled labour and the poor coordination of government policies. Yet despite their failure these cooperatives are still considered by the government as being vital for rural development.

However, despite all the problems facing agricultural development in Libya, continuous efforts are being made by the government to achieve success. For example, as a result of

these efforts and the increasing attention given to agriculture, the contribution of the agricultural sector to the GDP has increased from only 2.1% in 1980 to 9.9% in 2000, with the maximum allocations for agricultural development standing at LD1,8564 billion in the 1976-1980 development plans.

The contents of the fourth chapter of this study include preliminary information about the project regarding its location, climatic factors, land and agricultural resources and human and water resources.

Wadi-Al-Hai settlement project is located 85 km to the south of the capital Tripoli. This project occupies a total area of 12,000 hectares of the so-called Jafara Plain. Due to the lack of natural barriers to the north, the prevailing climate in the area is directly affected by the Mediterranean, which moderates the temperatures and reduces the effects of the semi-desert climate in the south. However, for most of time the winter rains affect the region carried to it by the humid winds originating in the Atlantic to the west moving in an easterly direction towards the neighbouring highlands that allow the flow of rainwater into the project areas.

Nonetheless, the soil has been classified into five categories ranging from the highly productive class one soil suitable for all types of crops to a poorly productive class five soil barely suitable for any agricultural activities.

Rainwater constitutes a main source for irrigation, which either precipitates directly in the project or indirectly floods the project through a dam established for this purpose.

Other sources include ground water, with different methods of irrigation involved such as spraying and dripping.

Two stages are involved regarding agricultural activities within the project. These are the first and second stages with 160 and 155 fields respectively. The agricultural activities are directly affected by the natural conditions, especially the lack of rains as is the case with the drought that has hit the area during 2002-2003 causing great damage to crops.

However shortages in drinking water are one of the major problems facing the inhabitants of the project, and therefore the need for more wells to provide clean water for drinking is urgent. Moreover, water for irrigation suffers from severe shortages to the extent that 3 hectares on average of every field are normally left unused. This problem stems from the fact that almost half of the wells either go dry or are not operating due to technical faults.

Yet, despite its problems the project has been, so far, of great benefit to farmers in improving their quality of living. This has been obvious from the services it has provided to this group of rural inhabitants, including decent housing, electricity, and health and education services.

The fifth chapter contains the results of the analysis of the questionnaire data. The agricultural activities in Wadi-Al-Hai project are divided into two stages i.e. the first and second stages. Both stages produce crops, fruits, and vegetables besides animal products

such as meat and milk. The crops mainly include cereals, which represent cash crops for farmers, given the fact that production is mainly dependent on rains. They include barley, forage and hay as a by-product used as animal feed. The fruit products include figs, grapes, dates and olives. The production of fruits is mainly to meet local demand, and any surplus will be distributed in markets all over the country. The vegetables include onions, watermelons and tomatoes. The productivity in vegetables is low, but nonetheless can be improved by improving the soil after adding the right amounts and types of fertilizers.

The agreed crop formation plan in the project is based on fruits as the main product and vegetables as secondary products. However, one of the main reasons for the low productivity is that farmers do not comply with the agreed crop formation, and also their poor knowledge of modern agricultural techniques, such as ways of combating pests.

Besides routine agricultural activities, animal farming is becoming significant given the huge incomes it generates to farmers. Hence most farmers in the project are becoming increasingly engaged in mixed farming activities, with goats and sheep being the main animals involved supplying the farmers with meat and milk.

The products are mainly marketed outside the project in neighbouring towns, and yet some of the products are marketed within the project. The importance of the outside markets stems from the fact that these markets represent a rendezvous for farmers, brokers and middlemen where the wholesale process saves the farmers time and effort, besides selling their products at reasonable prices.

To assist farmers undertake their duties in a proper and more efficient way, co-operatives have been established. The main objective of these cooperatives has been to provide the most necessary services such as equipment, fertilizers, and pesticides.

However, a survey of the farmers indicated that the majority believe that they have not been provided with the required services. This can be attributed to shortages in the finances of these cooperatives besides the scarcity of equipment and materials.

The main problem facing the project is that the majority of the farmers are illiterate, therefore making it difficult for the authorities to extend agricultural information and knowledge to them, which directly affects productivity. Another problem is that the majority of farmers i.e. in excess of 60% on average are engaged in other activities outside the farm given the advanced age of 50+ of most of them. Moreover in most cases the soil is sandy clay with poor productivity. Also in the past two years the meagre amounts of rains have resulted in drought causing the withering out of trees and crops.

The sixth chapter is based on an attempt to develop and estimate an econometric model of land use on the basis of the data collected from the questionnaire. The aim is to estimate, using a simple linear/log-linear model, the marginal contributions made by each explanatory variable in the model. In so doing, a simple but practical linear model was first developed. The estimated model using OLS was offered and their predictability was investigated. At best, only up to 70% of variations in the dependent variable could be explained by the explanatory variables, meaning that there still remained a significant size of variations in the dependent variable left unexplained. For

this reason, the remainder of this section was dedicated to discovering the nature of the error generated by the OLS.

The estimated model was subjected to test for multicollinearity, going beyond the rule of thumb suggested by Klein. The examination of both the partial and multiple correlations showed that there is no sign of multicollinearity present in our estimated model. Moreover, the examination of the standard errors of the estimated coefficients and the overall stability statistic (F-statistic) all reveal that the estimated model is free from any serious multicollinearity.

The model as it stood was also subjected to test for heteroskedasticity, using different techniques. It was then discovered, using the log-likelihood ratio, that there may exist some degrees of non-homoskedastic error. Having treated for heteroskedasticity, we then compared and contrasted the estimated results. The overall picture showed that the estimated coefficients tend to be highly significant, and relatively large in magnitude.

On the whole, it should be noted that the estimated findings are indicative of a rather stable, robust log-linear model. As explained earlier, a significant proportion of the variations in the dependent variable still remains unexplained, indicating that some fundamental, yet non-quantified, political/social elements need to included to improve the model.

The results of the study indicate that around 70% of the increase in the cultivated area of the project was associated with socio- economic independent variables. These variables

are considered in the following sequence farmer's attributes and input other things being equal. It has also been shown that a change of 10% in each of these factors will tend to increase the cultivated area of the project by 1.3% and 1.7% respectively, and that the function shows a total flexibility of 3% pointing towards the increasing returns of the increase in area related to these factors. Furthermore, this also confirms the fact that by focusing on these economic factors the productivity of the project can be augmented.

In chapter seven the study recommends a number of policies aiming at improving the agricultural resources of the project. These policies include improving the soil quality, the rational use of water resources, organising and improving production as well as improving the social conditions of the farmers.

In short, this study has reached a number of conclusions, which can be summarized as follows:

1- The huge majority of the farmers are either semi-illiterate or otherwise completely illiterate. Almost 75% of the farmers of the first stage as well as 76.9% of the second stage farmers are illiterate. This widespread illiteracy is closely associated with the older groups as these groups missed out on education at an earlier age.

2- The majority of the first stage farmers are aged 64 years and over constituting around 78.5%, whereas in the second stage they constitute 84.6%. This is a clear indication that most of the farmers have passed the age of maximum productivity, which will have a great bearing on production in terms of the cultivated area of Wadi El-hai project.

3- The cultivated area in Wadi El-hai project has been greatly affected by the fact that 65% of the first stage farmers as well as 60% of the second stage farmers are not fully

engaged in the farming process. These findings are consistent with those of Abu Zeid (1990).

4- Most farmers have ample farming experience, with 87.5% and 86.2% of them having 5 to 20 years experience in the first and second stage farms respectively.

5- Most of the first and the second stage farm have clay soil. Clay soil constitutes 62.5% of the first stage farms, and 75.4% of the second stage farms. Given the problems caused by clay, both production and the size of the cultivated area have been greatly affected. Again this finding is consistent with both Abu Zeid and (1990) Elshargawi, (1987).

6- Irrigation water has been inadequate and therefore insufficient to satisfy the requirements of all the farms. Only 65% of the first stage farms and 76.9% of the second stage farms received adequate quantities of water. This has resulted in the withering of plants and trees, especially fruit trees and rain irrigated plants such as almond and peaches. These finding are in agreement with the findings of the Iricard Organisation (1994).

7- The first stage farmers have concentrated on the cultivation of vegetables and forage, which have constituted 4.1 hectares per farm compared to an approved area of only 2.1 hectares per farm for these crops. In contrast the area allocated for vegetables and forage has been 6.4 hectares per farm in the second stage compared to only 0.75 hectares allocated by the approved crop formation plan. Fruit trees, on the other hand, are perennial and therefore need little attention from the farmers.

8- It has become evident that all farmers of the first stage possess tractors and small harvesters, and 92.5% of them possess trailers. However, in the second stage although all of them possess tractors, only 53.8% of them possess harvesters and around 66.5% possess trailers.

9- All farmers of both stages use chemical fertilizers.

10- Lack of supervision has led to farmers not complying with the proposed crop formation plan as well as the improper use of fertilizers, especially organic fertilizers. This has led to the spread of weeds all over the project, and the farmer's questionnaire indicated the complete absence of supervisors from the scene in both stages.

11- This study has shown that only 12.2% of the total inhabitants of the project perform duties related to agriculture compared to 19.7% who are either employees or perform other handicrafts. Yet, almost half of the inhabitants 49.4% are students who do not belong to the workforce in the project. Also the study has shown that around 0.3% of the inhabitants are idle, given the fact that all females including the housewives have been excluded from the workforce.

12- The study has revealed that the farmer does not usually consider farming as a full time occupation, but rather a part time and seasonal job. This understanding might have been due to the rationing of irrigation water, so that a farmer has no choice but to stick to the approved timetable, and therefore may sometimes find himself sitting around without work.

13- The irrigation sources for the project are mainly ground water, and the methods used for irrigation are spraying, dripping and flooding.

14- The economic and statistical analyses have shown that 70% of the changes that take place in the cultivated area is related to social and economic factors such as the farmers' attributes and inputs, other things being equal, therefore a 10% increase in the farmers' attributes is likely to produce an increase of 1.3% in land use. . On the other hand, a 10% increase in inputs, other things being equal, will lead to a 1.7% increase in land use.

On the whole, in the long run, when all factors can be assumed to vary, then a 10% increase in both factors will lead to a total increase in land use of as much as 3%.

15- The study has indicated that food, drink and transport absorb the bulk of the farmer's income. For example the total spending on food and drink is around 42.4% and 43.3% of the total earnings of the first and second stage farmers respectively. On the other hand the total spending on transport constitutes 19.4% in the first stage and 23.4% in the second stage.

16- The children of the farmers have various future aspirations away from the farming profession. These aspirations include teaching 42.9%, and medicine 23.8%, and only (19%) are anticipating to becoming farmers. Given these aspirations, the whole future of the project may be in doubt.

17- The total average cultivated area for the season 2002-2003 (the study season) was 19.6 hectares in the first stage and 21 hectares in the second stage, whereas the total area for the approved crop formation was 25 hectares in both stages.

In short, the study suggests that in the light of scarce resources (water, others, input), the Wadi Al-Hai project should be regarded as a valuable social project. However, the economic viability of the project is doubtful.

7.2. The Contributions of the Research

1- Preparation/visit and conducting questionnaire/interviews for the two phases of farming households – no such extensive research has yet been done in this project.

2- A cost-benefit approach has been applied here in contrast to previous work where only secondary (government published data) sources were used.

3- Measuring policy instruments and welfare elasticities using the data from the questionnaire.

4- The findings are expected to be of great assistance to policy-makers and different government agencies involved in similar projects.

7.3. The Main Axis of some Agricultural Policies Recommended to Exploiting the Natural and Human Resources at Wadi Al-Hai Project:

The proposed agricultural policies at the project mainly aim at using the materials available to farmers in a better and a more efficient manner, for the purpose of achieving a more economic use of the natural and human resources of the farm. This will have positive effects on production and the earnings of farmers, which will further lead to the development of the project. This policy has been based on the following four major axes:

7.3.1: The Policy of Improving the Characteristics of the Soil

The quantitative and qualitative economic analysis points to the importance of soil to agricultural production and development. However, as a matter of fact the farmers always prefer the use of good soil to cope with the ever-increasing demand for their products. Nevertheless, this implies that improving the soil of the farms will tend to increase production in these farms, therefore making them economically feasible. Then, this economic feasibility will encourage farmers to use more of the farms to boost production in favour of agricultural development. However, to reach that end a number of methods can be used, the most significant of which are:

1- The use of fertilizers with the right quantities and at the right time.

2- Good preparation of the land before use through mechanization in order to achieve a reasonable outcome.

3- The use of the crop rotation in the production plan, which will preserve the nutrients in the soil.

4- The use of nitrogen-based chemical fertilizers, phosphates, and potassium fertilizers in more economic manner according to the actual requirements of the soil, following the right scientific approach in determining the type, quantity and the right time for use.

7.3.2. The Policy of Improving the Water Resources

However, the economic and statistical analyses have shown that the farms in the project are suffering from water shortages. Hence, since water is a basic ingredient in agricultural development, then the later will also suffer. This has led the project authorities to consider new policies with regard to improving the use of the project resources. This policy is aimed at improving water resources in order to improve the economic efficiency of the project for the sake of the farmers' wellbeing and the society at large. The main features of this policy are the following:

1- The maintenance of broken wells by providing the necessary spare parts.

2- The reduction of economically infeasible crops, specifically crops that consume large quantities of water.

3- The concentration on winter, spring and autumn crops, and avoiding summer crops to minimise water consumption.

4- Speeding up plans for supplying water from the south through the "Great Man Made River" project. This will release the pressure on ground water to providing the necessary water for irrigation.

5- Improving the knowledge of farmers through educational programmes so that they can use the available water resources in a more effective manner. These programmes can be conducted either through direct supervision or through radio and TV.

6- Providing well-trained technical staff to monitor the water supply and sewage networks and look after the modern equipment through regular maintenance.

7.3.3. The Policy of Plant Production

Plant production through crop rotation implies the existence of both winter and summer crops in the crop formation. However, the best crop formation is that which will achieve the maximum economic outcome without producing damage to the soil or affecting its fertility.

Yet, the current crop formation plan of Wadi Al-Hai project appears to be imperfect and in some ways defective. For example, this crop formation does not cover a full rotation and therefore does not use the farmland in a more intensive manner. Hence this will imply a review of the current crop formation by introducing the necessary improvements to produce a more effective and feasible one. The following are the main characteristics of a successful crop formation:

1- Any successful crop formation will tend to preserve the soils' characteristics. However, it is always recommended that the crop formation should incorporate some of the plants that will add nodular bacteria to the soil and therefore will supply ample quantities of nitrogen, which is the most important nutrient. Yet, since the soil of the project is nitrogen deficient, then these provisions will preserve fertility leading to more production. Fertility can also be augmented by the use of nitrogen-based chemical

fertilizers. Also the cultivation of clover (Alfalfa) and legumes will add to the nitrogen contents of the soil.

2- The proposed crop formation should also incorporate crops related to the food industry, so that industry and agriculture can be integrated for the sake of the welfare of rural society. This integration will provide jobs, enhance agricultural production and in the end will increase the final income of farmers and the project as a whole.

3- In order to produce more diversification it is proposed that the ideal crop formation should incorporate all crops in addition to vegetables and fruits. Apart from its great benefits in preserving the soil fertility, this formation has the potential to diversify agricultural income and continuously provide farmers with cash crops.

7.3.4. The Policy of Improving the Social Conditions for Farmers

The social status of an individual always has great bearing on production as well as the use and management of resources. Therefore it is not surprising that the social conditions of farmers are likely to affect their capabilities and their production activities in terms of the cultivated land in the project. Hence, improving the social conditions of the farmers should become a priority. However, this can be achieved through improving their incomes so that they will be able to provide better living standards for their families, providing them with clothing, housing, healthcare, entertainment and so on.

Therefore, to reach this end, policies such as improving soils' characteristics and the water resources, and achieving a more effective crop rotation plan are necessary. These policies will tend to improve the incomes of farmers and consequently living standards in the whole project.

7.4. Evaluation of Wadi Al-Hai Settlement Project in the Light of the Approved Plan

This project was established on the basis of a clear-cut plan, where all the farmers, efforts would help towards achieving its objectives, which are the following:

1- Increasing both animal and plant production through the proper use of the natural and human resources available. This would eventually lead to self-sufficiency by providing these products to the consumer at affordable prices.

2- Keeping people in rural areas and therefore curbing immigration into urban areas. This could be achieved by making use of the natural resources available at the project, and by providing the necessary services in the settlement areas.

3- The project also aims at securing a decent income for farmers.

4- The allocation of the farmlands of the project according to a specific scheme for production and crop formation. Such schemes are usually associated with well-organized crop rotation plans. The requirements for production are then provided on the basis of this plan.

Thirty years on, a field survey was conducted to establish the extent of delivery on the above objectives, as seen by the farmers, and the survey has revealed the following facts:

1- The available resources have not been used in an ideal way, resulting in poor productivity, even though self-sufficiency has been achieved in some of the products.

2- Most of the rural population has been settled in their areas by providing them with modern farms with state of the art equipment and modern houses.

3- The incomes of farmers have improved, exceeding the average income of workers in other sectors in urban areas.

4-The farmers have not complied with the proposed crop rotation plan. Instead most farmers have been concentrating on cash crops such as fruit and vegetables, neglecting other crops prescribed by the plan.

7.5. The Main Problems Facing the Farmers

Numerous problems exist that frequently interrupt farming activities and hamper production. These problems can be summarised as follows:

1- Shortages in irrigation water, and the frequent breakdown of the pumping system in recent years.

2- Severe shortages in forage, especially during times of inadequate rain, when local production is meagre and imports are insufficient.

3- Significant shortages in spare parts and agricultural equipment. However, most of the available equipment is either broken down or inefficient because of old age.

4- Animal and plant diseases are rampant.

5- The necessary fertilizers and modified seeds are not usually delivered at the right times. This delays the cultivation of some crops and affects production.

6- Marketing problems and the lack of adequate markets to absorb production.

7- The lack of proper supervision programmes.

8- The failure of farmers to comply with the approved plan for crop rotation, instead concentrating on certain crops.

9- The indifference and neglect shown by farmers who are engaging in other activities outside the farm at the expense of their farming duties.

7.6. Limitations

The data is based on the material that is available, and as such shows some limitations. No figures, for example, are available for agricultural productivity. This study has had to rely on what people said and the author's own observations, as there have been no previous studies of this project. This does mean that the empirical data in this study should be regarded as tentative and suggestive rather than entirely conclusive, since there is no other data available for the project against which the results can be compared.

This study should be seen as exploratory work, which will hopefully be followed by further studies of more than one season.

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Appendix (A)

THE QUESTIONNAIRE

English translation of questionnaire administered in Arabic to settlers in settlement projects in the Wadi Al-Hai region.

Q-1 FARM NUMBER ( )

Q-2 FARMER`S AGE ( )

Q-3 EDUCATIONAL LEVEL

A-PRIMARY ☐

B-SECONDARY ☐

D-COLLEGE ☐

C-UNIVERSITY ☐

Q-4 NUMBER OF YEARS IN THE AGRICULTURAL DOMAIN ( )

Q-5 THE KIND OF THE WORK OUTSIDE THE FARM ( )

Q-6 NUMBER OF FAMILY WORKERS ( )

Agriculture	An employee	An unable	Student	Others

Q-7-DO YOU LIVE ON THE FARM?

A- YES ☐ B- NO ☐

Q-8 NUMBER OF THE PRODUCTIVE WORKERS IN THE FARM? ( )

Q-9 NUMBER OF PERMANENT WORKERS IN THE FARM? ( )

Q-10 AGRICULTURAL EXPERIENCE OF THE WORKERS IN THE FARM

( )

Q-1 TOTAL AREA OF THE FARM ( )

Q12 EXPLOITED AREA ON THE FARM ( )

Q13 AREA NOT EXPLOITED ( )

Q14 EXPLOITED AREA FOR DRY AGRICULTURE ( )

Q15 EXPLOITED AREA BY IRRIGATION ( )

Q16 METHOD OF IRRIGATION USED ON THE FARM?

A- SPRAYING ( )

B- DRIPPING ( )

C- FLOODING ( )

Q18 SOURCE OF IRRIGATION

A- WELLS ( )

B- DAMS ( )

C- OTHERS ( )

Q19 SOIL QUALITY?

A- SANDY ( )

B- CLAY ( )

C- SANDY AND CLAY ( )

D- OTHERS ( )

Q-20 SOIL FERTILITY

A- GOOD ( )

B- AVERAGE ( )

C- POOR ( )

Q-21 AGRICULTURAL EXPLOITED AREA FOR FRUIT TREES, PRODUCTION QUANTITY AND COSTS

TREES	AREA	NUMBER	ANNUAL PRODUCTION (Tons)	COSTS	SALE VALUE
GRAPES					
FIGS					
PALMS					
PLUMS					
APPLES					
ALMONDS					
OLIVES					
OTHERS					
TOTAL					

Q-22 WHAT CROPS WOULD YOU LIKE TO CULTIVATE?

A- GRAINS ( ) B- VEGETABLE ( ) C- FRUITS ( )

D- FORAGE ( )

Q-23 WHY DO YOU LIKE THIS KIND OF AGRICULTURE?

A- HIGH DEMAND ( )

B- HIGH SALES PRICES ( )

C- DOES NOT REQUIRE A GREAT DEAL OF MUSCULAR EFFORT ( )

Q-24 AGRICULTURAL EXPLOITED AREA FOR CROPS AND VEGETABLES, PRODUCTION QUANTITY AND COSTS

CROP	AREA	ANNUAL PRODUCION (Tons)	COSTS	SALE VALUE
FORAGE				
WHEAT				
BARLEY				
TOMATOES				
WATERMELLOW				
POTATOES				
PEPPERS				
TOTAL				

Q25 DOES THE INCOME OF THE FARM COVER COSTS?

A- YES ( ) B- NO ( )

Q-26 ARE THE FOLLOWING PRODUCTION INPUTS READILY AVAILABLE?

A- FERTILIZER ( )

B- SEEDS ( )

C- INSECTICIDES ( )

D- MEDICINES ( )

C- FORAGE ( )

Q-27 FROM WHERE DO YOU GET YOUR INPUTS?

A- COOPERATIVE ( )

B- COMPANY OF AGRICULTURAL REQUIREMENT ( )

C- OTHERS ( )

Q-28 DOES THE AGRICULTURAL INSTRUCTOR VISIT YOUR FARM REGULARLY?

A- YES ( ) B- NO ( )

IF (YES): -

A- DAILY ( )

B- WEEKLY ( )

C- MONTHLY ( )

D- WITHOUT APPOINTMENT ( )

Q-29 WHO USES THE AGRICULTURAL MACHINERY ON THE FARM?

A- FARMER ( ) B- SONS ( )

C- PROJECT MANAGEMENT ( )

D- OTHERS ( )

Q-30 DO YOU USE FERTILIZERS ON YOUR FARM?

A- YES ( ) B- NO ( )

C- SOME TIME ( )

IF THE ANSWER IS YES OR SOMETIMES, PLEASE COULD YOU SPECIFY THE KIND?

KIND OF FERTILIZER	QUANTITY	KIND OF PLANT
AN ORGAN		
A CHEMICAL		
TOTAL		

Q-31 KINDS OF TOOLS ARE USED ON THE FARM?

TOOL	NUMBER	VALUE	BELONGS TO FARM	BELONGS TO PROJECT	BELONG TO CO-OPERATIVE	FREQUENCY OF USE	
						SEASONLY	DAILY
TRACTOR							
CAR							
WATER PUMP							
TUBES							
SOWING MACHINE							
SMALL HARVEST MACHINE							
TRAILER							
FORAGE PRESSER							
LORRY							
TOTAL							

Q-32 WHERE DO YOU SELL YOUR AGRICULTURAL PRODUCTS?

A- GENERAL POPULAR MARKETING ( )

B- GENERAL COMPANY OF MARKTING ( )

C- IN THE FARM ( )

D- OTHERS ( )

Q-33 HOW DO YOU TRANSPORT THE FARM PRODUCTS?

A- BY PRIVATE CAR ( )

B- BY THE PROJECT`S CAR ( )

C- BY RENTING A CAR ( )

D- OTHERS ( )

Q-34 WHO IS IN CHARGE OF SELLING THE FARM'S PRODUCTS?

A- FARMER ( )

B- COOPERATIVE ( )

C- FARMER`S SONS ( )

Q-35 WHAT WERE THE TOTAL SALES IN THE PREVIOUS SEASON/YEAR?

KIND OF PRODUCTION	QUANTITIES	UNIT PRICE AVERAGE	INCOME RATE FOR EACH CROP	NOTES

Q36 WHAT ARE THE ANNUAL INCOME AND COSTS FOR ANIMAL HUSBANDRY?

KIND OF ANIMAL	NUMBERS	COSTS	ANNUAL INCOME
SHEEP			
GOATS			
CAMELS			
POULTRY			
BEEF AND CATTLE			
TOTAL			

Q37 WHAT IS THE TOTAL GROSS ANNUAL INCOME FOR THE FARM?

( )

Q-38 WHAT IS THE FARMER`S NET ANNUAL INCOME?

( )

Q39 DESIRES AND ABMITIONS OF THE FARMER`S SONS FOR THE FUTURE?

TEACHER	ENGINEER	DOCTOR	FARMER	ADMINSTRATOR	OTHER

Q-40 WHAT IS THE FAMILY EXPENDITURE PER MONTH?

( )

Q-41 THE MAIN PROBLEMS FACING THE FARMER, AND POSSIBLE SOLUTIONS?

A- PROBLEMS: -

B- SOLUTIONS: -

Appendix (B)

Table 3.1: Development of expected and actual agrarian production quantities

During the Tri Plan years 1973-1975

Agrarian Products	Average (1) 1969-70	Actual production (2) 1972	Preliminary Estimates (3) 1972-73	Estimates (4) 1973	Estimates (4) 1974	Results for the year 1975		
						Expected (5)	Expeceted (4)	Actual (6)
(wheat)	49.8	41.6	80.0	90.0	120.0	107.o	200.0	75.0
(Barley)	88.4	116.4	135.o	150.0	170.0	216.0	200.0	192.0
(Vegetables)	201.0	382.2	-	-	-	620.0	-	564.0
(fruit &Olives)	142.4	204.9	-	-	-	250.0	-	248.0
(forage)	-	-	-	-	-	616.0	-	351.0
(Dairy)	51.1	51.3	56.9	66.7	78.7	85.0	-	87.0
(Meat)	42.3	33.4	29.0	30.6	34.1	46.0	-	44.0
(Grains,seeds)	12.8	18.7	-	-	-	24.0	-	19.0
(Eggs)	2.4	2.9	4.9	5.7	6.9	9.0	-	10.0
(Honey)	-	93 tons	290 t0ns	431 tons	734 tons	350 tons	-	235 tons
(Other)	-	-	-	-	-	8.0	-	-

Source: Preparation of researcher according to following sources:

(1) Achievements of first September Revolution
(2) Transformation plan (1976-1980)
(3) Tri plan (1973-1975)
(4) Tri plan (1973-1975)
(5) Transformation plan (1976-1980)
(6) Achievements of Revolution

Table 3.2: Development of expected and actual agrarian production quantities

During the transformation plan (1976-80) & (1981-1985)

Agrarian products	1976		Actual Production 1977 (2)	Actual Production 1978 (2)	1979		1980		1985	
	Expected (1)	Actual (2)			Estimated (4)	Anticipated (2)	Expected (1)	Estimated (3)	Expected (3)	Actual
(Wheat)	156	130	57	99	110	110	336	140.5	428.8	
(Barley)	224	196	59	196	150	100	245	71.5	105.6	
(Vegetable)	670	544	532	565	600	575	825	658.4	779	
(Fruit & Olives)	264	391	188	157	290	190	403	312	344	
(Forage)	889	93	400	360	-	240	132.1	390	657	
(Dairy)	-	42	80	87	80	80	99	110	308	
(Meat)	-	39	41	39	52	42	98	58.6	130.4	
(Grais,seeds)	27	21	20	20	26.5	20	-	-	-	
(Eggs)	-	11	11	13	15	15	14	15.5	45.3	
(Honey)		240 tons	337 tons	345 tons	-	350 tons	-	360 tons	400 tons	
(Other)	9.5	-	-	-	-	-	14	-	-	

Source: Preparation of researcher according to the following sources:

(1) Transformation plan (1976-1980)
(2) Transformation plan (1981-1985) second part.
(3) Summary of transformation plan (1981-1985) part one and part two.
(4) Achievements of Revolution.

Table 3.3: Quantitative Expectations, Actual Production & Self-sufficiency

(1972-1985)

YEAR	Anticipated Production		Expected Needs		self-sufficiency %		Actual Production		self-sufficiency %	
	Wheat	Barley	Wheat	Barley	Wheat	Barley	Wheat	Barley	Wheat	Barley
1972	--	--	--	--	--	--	41.6	116,4	--	--
1972-73	--	--	--	--	--	--	80	135	--	--
1973(1)	90	150	320	210	28.1	71.4	--	--	--	--
1974	120	170	320	125	36.4	75.6	--	--	--	--
1975	200	200	350	250	57.1	80	75	192	21.4	76.8
1976	156	244	376	40	41.5	560	130	196	34.6	490
1980 (2)	303	245	410	35	73.9	700	140.5	71.5	34.3	204.3
1985 (3)	428.8	105.6	569.5	105.6	75.3	100	--	--	--	--

Source :- Preparation based upon following information

(1) Tri plan (1972-1975)
(2) Transformation plan (1976-1980)
(3) Transformation plan (1981-1985)

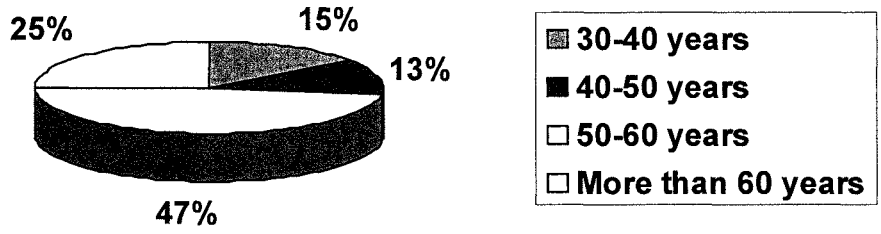
Table 3.4: Gross Domestic Product by Economic Sectors

Activity	1970	1975	1980	1985	1990	1995	1999	2000
Oil	63.1	53.37	61.83	44.58	35.5	24.6	22.8	23.4
Mining and quarrying	0.1	0.56	0.46	0.63	1.4	1.5	1.5	1.4
Agriculture	2.6	2.25	2.11	4.36	4.4	9.4	10.8	9.9
Manufacturing	1.7	1.8	2	5.37	7.2	8	6.6	6.6
Electricity	0.5	0.48	0.46	1.42	2	2.1	1.9	2
Construction	6.8	11.83	10.44	8.62	6	4.8	5.2	4.8
Trade	3.6	6.11	4.89	7.29	10.3	12.5	13.8	9.3
Transportation	3.4	4.78	3.98	6	8.4	8.9	8.9	13.4
Finance	1	2.69	2.33	3.23	3.7	2.8	3.3	3
Housing	4.6	3.56	1.98	3.19	4	3.9	3.5	3.6
Education services	3.1	3.34	2.18	5.46	5.5	7.3	6.5	6.9
Health services	1.3	1.4	1.08	2.36	2.5	2.9	3.4	3.6
Other services	7.6	7.02	5.68	6.3	7.1	8.2	8.7	9.3

Source: - Central Bank of Libya (2000) Annual Report

Appendix (C)

Figure 5.1 Age Structure of The Farmers in The First Stage Farms



Figuer 5.2 Age Strucure of The Farmers in The Second Stage Farms

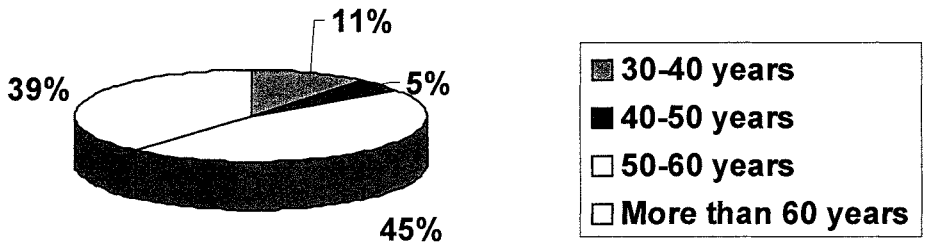


Figure 5.3 Education Level of TheFarmers in The First Stage Farms

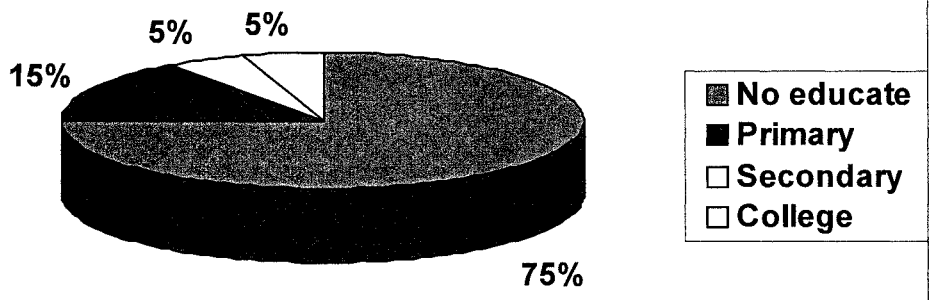


Figure 5.4 Educatin Level of The Farmers in The Seconed Stage Farms

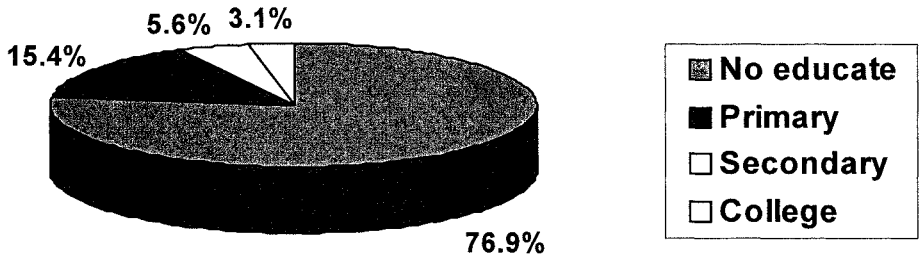


Figure 5.5 Devotion to Agricultural Work in The First Stage Farms

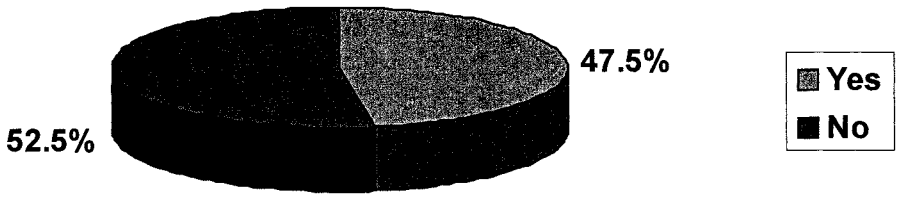


Figure 5.6 Devotion to Agricultural Work in The Seconed Stage Farms

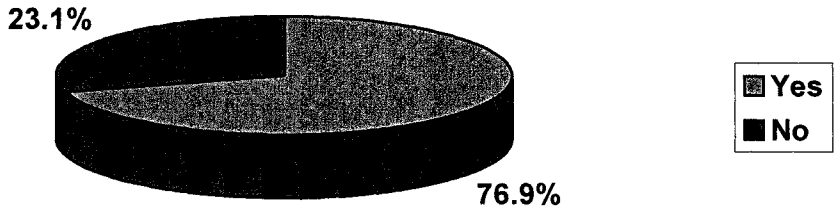


Figure 5.7 Agricultural Experience in The First Stage Farms

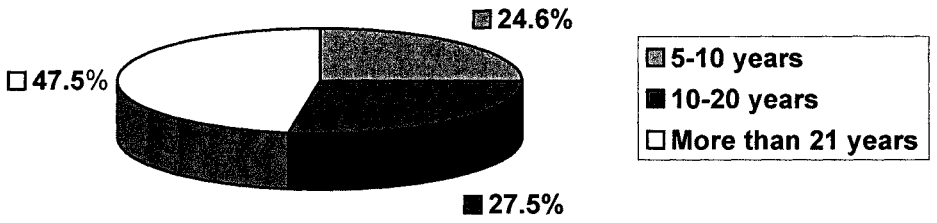


Figure 5.8 Agricultural Experience in TheSecond Stage Farms

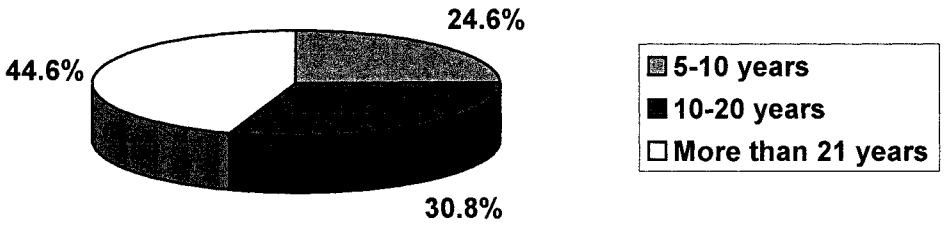


Figure 5.9 Soil Quality in The First Stage Farms

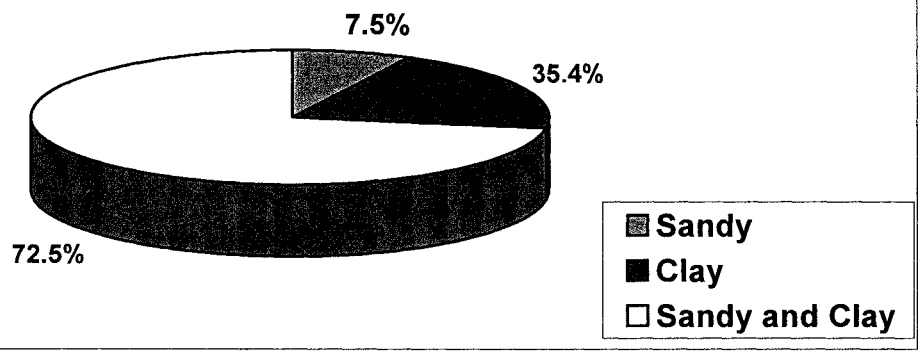


Figure 5.10 Soil Quality in The Second Stage Farms

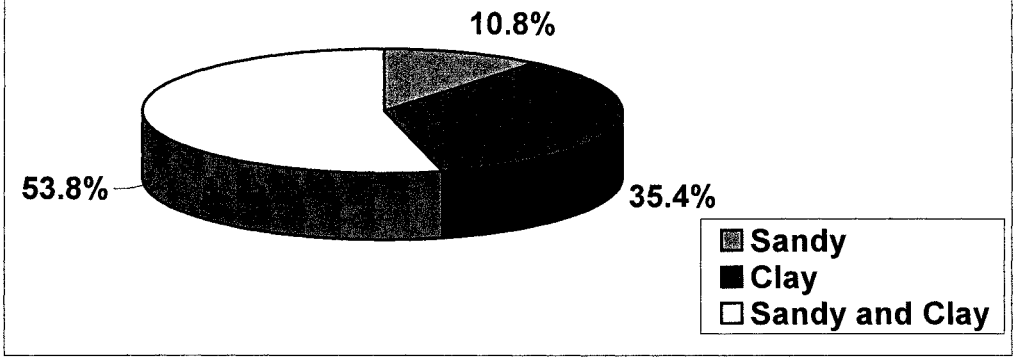


Figure 5.11 Adequacy of Water in The First Stage Farms

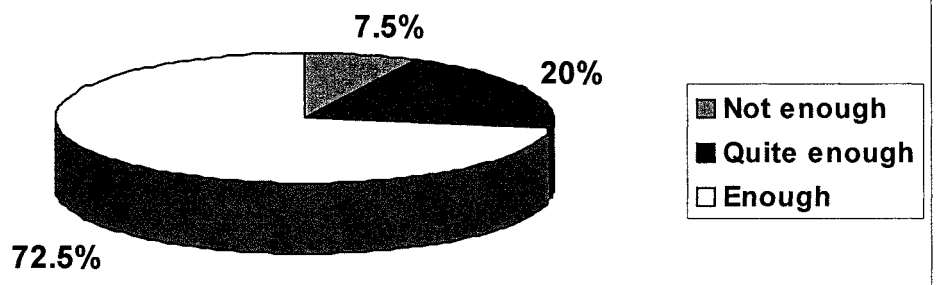


Figure 5.12 Adequacy of Irrigation Water in The Second Stage Farms

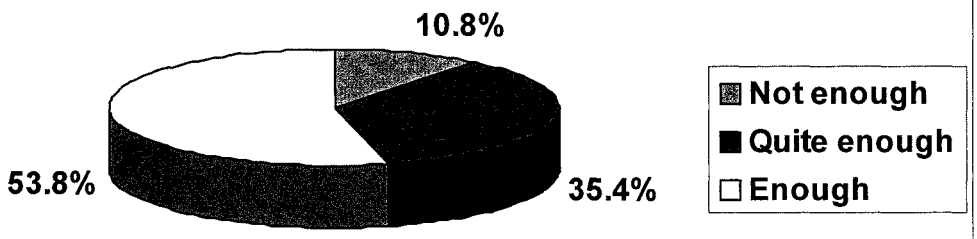


Figure 6.1 Land use