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6-7 April 2002
National Conference on Qat

المؤتمر الوطني بشأن القات

رؤية وطنية حالة بمستقبل واعد

(وثائق المؤتمر)

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تنظيم
بالتنسيق مع
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وزارة الزراعة والري

Under the Auspices of H.E
The President of Yemen
Mr. Ali Abdula Salleh

National Conference on Qat

Conference Discussion Materials

Gatter, Peer, Qahtan Abdul Malik & Khlalid Sae'ed (Editors)

Organized by
Ministry of Planning & Development
and
Ministry of Agriculture & Irrigation.

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First National Conference on Qat

Conference Discussion Materials

Under the Auspices of H.E. the President of Yemen, Mr. Ali Abdula Salleh

Organized by

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The opening of the First National Conference on *Qāt* held in April 2002 in Ṣan‘ā’s Officer Club. In the center (top row) Prime Minister ‘Abd al-Qādir BāJamāl, to his left the Minister of Planning Aḥmad Muḥammad Ṣūfān and to his right the Minister of Agriculture, Aḥmad Sālim al-Jabalī. Seated below them are members of the conference secretariat, from left to right: Khālid Muḥammad Sa‘īd, General Director for Agriculture, Water and Fisheries, Qaḥṭān Yaḥyā al-Aṣbaḥī, Director of the Water Monitoring Unit, and Fārūq Qāsim, Director of Agricultural Planning

National Conference on Qat

Conference Discussion Materials

Sana'a-6-7 April 2002

YEMEN

Edited by:

Peer Gatter, & Qahtan Abdul Malik and Khaled Sae'ed

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Organized by the Ministry of Planning & Development and the Ministry of Agriculture & Irrigation.

Introduction

In July 1999, the cabinet instructed the Ministry of Planning and Development and the Ministry of Agriculture and Irrigation to prepare for a National Conference on Qat which will bring together Government, donors and civil society to discuss the impact of Oat on Yemen's society and economy. The objective is to discuss problems and solutions, and thereby help develop a national policy and action plan on Qat based on the recommendations of the conference.

To supervise the conference preparation a Steering Committee was formed in October 1999 including representatives of a number of Ministries, Parliamentarians and members of other Government entities. Following its guidelines a Technical Group and a Conference Secretariat were established and assigned to prepare for and hold the conference.

Starting End of 1999, studies on different aspects of the Qat issue were commissioned with the aim to sum up the current status of knowledge on the plant.

Very quickly it became however clear that on some vital issues of Qat, such as the role of plant in the rural economy, its marketing, and the impact of Qat on low income families no sufficient and that is more no reliable information was existing. Due to the importance of these subjects it was decided to carry out a number of field studies to fill these knowledge gaps.

Result of this exercise is a synthesis of information, some studies being the product of an extensive literature review, others the outcome of first hand field research. The reason for carrying out these studies was to provide a solid base of factual knowledge about Qat, as a prelude to some suggestions about possible policy options. The studies attempt to be neutral and objective about a subject, which is frequently discussed in terms of value judgments. Thus the studies attempt to explore the technical, social and economic issues, giving recommendations on how to address the Qat phenomenon, without however taking a position on whether qat is "good" or "bad" for Yemen or Yemenis.

The experts & specialists in this field believe that objective analysis and practical advice are most appropriate; that the concentration on the highly negative aspects of Qat need to be tackled more than that it is impractical to talk of eradicating it or even of reducing consumption significantly, at least in the short term. This approach would require support to developing a political consensus, and practical advice on mitigating the negative aspects; also cooperation among the government and non-government organizations is also required to deal clearly on Qat phenomenon.

Based on the awareness of the political leadership represented by H.E. Mr. Ali Abdula Saleh the president of Yemen, and the government on the importance of Qat phenomenon & the necessity to deal seriously with it. For that reason a cabinet decree has been issued to hold a National Conference on Qat, to address the issues related to Qat, which were studied and conducted during the last two years. The main objective of this book which is containing all results of that studies, is to increase the participatory approach of the society in discussing these issues depending on clear knowledge and towards reaching common consensus on dealing and tackling this phenomenon.

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National Conference on Qat

CONFERENCE DISCUSSION MATERIALS

First Topic
Health Impact of Qat Chewing

Health Impact of Qat Chewing

By

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Executive Summary

The Qat plant (*Catha edulis* Forsk., a tree of the Celastracease family) is cultivated in certain areas of East Africa and the Arabian peninsula and its leaves are chewed for their central stimulant effects (*Luqman et al.*, 1976). In Yemen, chewing Qat leaves is a widespread habit with a deeply rooted sociocultural tradition. Many Yemenis chew qat due to the pleasurable stimulanting properties of the plant aa well as in order to to avoid fatigue, keep awake at night and work longer hours.

In his review on medical aspect of Qat chewing, *Halbach* (1972) concluded that Qat is an amphetamine-like agent, a finding that was supported by chemical evidence. The leaves of the Qat contain a number of substances including phenylalkylamine compounds, such as nor-pseudoephedrine (cathine) and alpha aminopropiophenone (cathinone), structurally related to amphetamines (*Szendrei*, 1980) and also have pharmacological both central and peripheral actions similar to amphetamine (*Kalix*, 1981 and 1990).

Qat leaves also contain considerable amounts of tannins (7-14 percent in dried material), vitamins, minerals and flavonoids (*Halbach*, 1972 and *Kalix et al.*, 1985).

It is currently believed that the main active ingredient in Qat is cathinone, an amphetamine like substance (*Kalix*, 1990).

However, there are few quantitative studies in humans about the pharmacological effects of Qat chewing.

The objective of this literature review was therefore to explore studies on Qat, particularly studies on humans with special reference to those on Qat and its relationship to common diseases.

1. Introduction

Qat has been used since antiquity for recreation. Because of its stimulating effects habitual Qat chewers use it when travelling, especially during long distance motor vehicles rides. But also students use the leaves when preparing for their examinations since it increases concentration during reading.

Moreover, Qat chewers claim that Qat chewing is useful in diabetic patients since it lowers the blood glucose, as a remedy for asthma, and eases symptoms of intestinal tract disorders (*Al-Mashal et al.*, 1985 and *Amrein*, 1985).

Opponents claim that Qat damages health. Therefore, a number of studies have been made in an attempt to throw light on the health problems associated with Qat chewing.

Qat chewing is an insidious habit that affects many aspects of life with its adverse social, economic and medical consequences, it has become a problem of grave national concern (*Yousef et al.*, 1995).

2. Psychological Effects of Qat

The effect that accounts for the popularity of Qat is its stimulation of the central nervous system which is believed to be induced by cathinone, an active ingredient of Qat leaves (*Kalix*, 1990).

Many studies showed that psychostimulant effects induced by Qat chewing could manifest themselves in a moderate degree of euphoria and mild excitement resulting in promoting social interaction and causing loquacity (*Kalix et al.*, 1985; *Kalix*, 1987 *and Granek et al.*, 1988). While attaining a state of subjective well-being, the chewers feel an increase in alertness and energy together with an enhanced depth of perception (*Kalix*, 1990 and *Randall*, 1993). These effects were observed in a period of 1.5 -3.5 hours after the starting of the Qat chewing (*Nencini et al.*, 1986) and they were progressively replaced by mild dysphoria (*Nencini et al.*, 1986), anxiety, reactive depression, (*Hassan et al.*, 2000) insomnia, (*LeBars et al.*, 1965; *Halbach*, 1972 and *Hassan et al.*, 2000) and anorexia (*Heymann et al.*, 1995 and *Hassan et al.*, 2000).

These psychic effects of Qat chewing recall those of amphetamine (*Wilder et al.*, 1994). However, psychic effects of Qat are expressed in a social environment, i.e. in Qat sessions (*Nencini et al.*, 1986).

However, It has been suggested that the differences of effects of Qat and amphetamine are being quantitative rather than qualitative (i.e. there is a natural limat in ingesting large amounts of qat, which are however needed to cause the same effects like amphetamine) (*WHO*, 1964 and *Eddy et al.*, 1965).

It has been also reported that the Qat-induced behavioural syndrome can be described as hypomania, it may include hyperactivity and talkativeness (logorrhoea) (*Halbach*, 1972).

(a) Qat and Psychosis

In recent years Qat induced psychosis has become more common in Europe (*Yousef et al.*, 1995). Qat may cause a functional psychosis following consumption of exceptionally potent material, taken in excess or by predisposed persons (*Halbach*, 1972; *Kalix et al.*, 1984 and *Critchlow et al.*, 1987). In one case report in the UK Qat appears to induce in some cases a full-blown paranoid psychosis with the added complication of suicide attempt (*Critchlow et al.*, 1987). Moreover, a number of reports of psychiatric disorders secondary to Qat chewing with features of manic-like psychosis (*Giannini et al.*, 1982), schizophreniform psychosis (*Gough et al.*, 1984), paranoid psychosis (*Pantelis et al.*, 1989), or symptoms of acute schizophrenia-like psychosis were documented (*Gough et al.*, 1984 and *Yousef et al.*, 1995). A 1988 report indicates that a substantial number of chronic Qat chewers experienced persistent hypnagogic hallucination (*Granek et al.*, 1988) and first rank symptoms of acute schizophrenia-like psychotic disorders (*Yousef et al.*, 1995). In Kenya, a study has shown that grossly excessive chewing lead to psychotic states which are paranoid in type and transitory in nature. However, when Qat was chewed in moderate quantities, there was no increase in psychiatric morbidity (*Dhadphale et al.*, 1988). Similarly, a student in the USA of North America descent developed a manic psychosis following ingestion of Qat which he had grown in his own apartment (*Critchlow et al.*, 1987).

(b) Qat and Insomnia

A common effect of Qat use is insomnia, a condition that the users sometimes try to overcome with sedatives or alcohol (*Kalix*, 1987). The effects of simultaneous, and sometimes excessive smoking mainly cigarettes may also influence the symptoms produced by Qat (*Halbach*, 1972). It has been also reported that failure to abstain from Qat use may prolong a psychotic episode, even during treatment with antipsychotic medication (*Yousef et al.*, 1995 and *Alem et al.*, 1997).

(c) Tolerance and Dependence

In comparison with amphetamine, Qat is much more unlikely to cause tolerance (*Kennedy et al.*, 1980). In particular, the central nervous system effects of Qat do not seem to be subjective to the development of tolerance (*Halbach*, 1972), but a certain degree of tolerance to some central nervous system effects as insomnia (*Luqman et al.*, 1976) and anorexia (*Nencini et al.*, 1988) have been observed in most chronic Qat chewers.

In view on the dependence issue of Qat, a WHO Expert Group on drug dependence has concluded that Qat consumption may induce a persistent psychic dependence rather than physical dependence (*Eddy et al.*, 1965), albeit a certain degree of psychological dependence can occur (*Baasher*, 1980). However, the withdrawal symptoms after prolonged Qat use seem to be limited, to lethargy, mild depression, slight trembling and recurrent bad dreams (*Halbach*, 1972 and *Kennedy et al.*, 1980) While, no physical symptoms of withdrawal from Qat have been reported, only rebound phenomena rather than a specific abstinence syndrome have been described (*Luqman et al.*, 1976 and *Giannini et al.*, 1986).

According to the definition of WHO, Qat is not classified as an addictive drug (*Adam et al.*, 1994).

A report from Ethiopia confirmed the simultaneous use of cigarettes, alcohol, gasoline inhalation and glue-sniffing with Qat. Therefore, Qat is rarely used by itself. It appears that the pattern of Qat use among university students is similar to that reported for substance abuse in other countries (*Zein*, 1988).

(d) Psychiatric Condition and Crime

Recently, *Alem* and *Shibre* (1997) considered Qat as a substance of abuse and its chewing has the potential to complicate psychiatric conditions and forensic events.

Preliminary data of thirty psychotic male patients who were admitted to psychiatric section in Sana'a because of criminal history has been analysed.

Results of these preliminary data indicate that Qat chewing in psychotic patients was probably associated with disturbance of mood and behaviour and aggrevation of delusion symptoms (*Ali et al.*, 2000). Similar findings were reported by other authors (*Giannini et al.*, 1982; *Gough et al.*, 1984; *Critchlow et al.*, 1987; *Dhadphale et al.*, 1988; *Pantelis et al.*, 1989 and *Alem et al.*, 1997).

There was also a possible link between the habit of Qat chewing and the timing of crime attack. Also domestic violence seems in some cases to be induced by Qat consumption.

Certainly, these data need further investigations and control trials are recommended on this aspect.

3. Physycal Effects of Qat

(a) Qat and Blood Pressure

Recent work on 80 Yemeni healthy volunteers provided evidence that Qat chewing has induced a significant rise of arterial blood pressure and pulse rate parameters in comparison to the pre-Qat zero time (baseline values) (*Hassan et al.*, 2000). These findings have been also observed in small studies when pure cathinone in gelatine capsules was taken orally (*Brenneisen et al.*, 1990). *Nencini et al.*, (1984) have also observed elevation of arterial blood pressure parameters among 13 Qat chewing volunteers.

Moreover, it has been noted that the peak effect for the arterial blood pressure parameters and pulse rate, was reached 3 hours after starting Qat chewing followed by a decline 1 hour after the spill out of Qat (*Hassan et al.*, 2000). These findings are consistent with changes in plasma cathinone level after Qat chewing described by *Halket et al.*, (1995). These observations clearly support that cathinone is the constituent that is mainly responsible for the increasing arterial blood pressure and pulse rate parameters during Qat chewing. A possible mechanism is the release of catecholamines from presynaptic storage sites resulting in a variety of peripheral sympathomimetic actions (i.e. the release of hormones which stimulate the nerves) induced by cathinone which is currently believed to be the major pharmacological active constituent of Qat leaves (Kalix, 1990). Similar observations in smaller number of subjects were reported by Kalix (1990), Brenneisen et al., (1990) and Wilder et al. (1994). This effect on blood pressure has been confirmed by a randomized clinical trial exploring the effect of drug-herb interaction on blood pressure (Hassan et al., 2000).

Therefore, it can be concluded from the previous studies that Qat induced blood pressure elevation was probably mediated through its cardiac action. It seems likely that Qat chewing carries a cardiovascular risk in patients with hypertension and heart diseases (*Hassan et al.*, 2000), and may precipitate the occurrence of paralysis (cerebovascular accident) and heart attack (myocardial infarction) in susceptible individuals (*Gendron et al.*, 1977). It is therefore recommended that such patients should avoid Qat chewing.

(b) Qat and Digestive System

The effects of habitual Qat chewing on the gastrointestinal tract include symptoms suggestive of stomatitis, oesophagitis and gastritis. These effects are believed to be caused mainly by the strongly astringent tannins in Qat (*LeBars et al.*, 1965 and *Kennedy et al.*, 1983).

Stomatitis with secondary infection and periodontal disease are commonly observed in habitual Qat users (*Luqman et al.*, 1976). Gastric symptoms were attributed to hypotonic stomach (i.e. poor contractility) resulting from the effect of cathine and its precursor on the nerves of the stomach (sympathomimetic action) (*LeBars et al.*, 1965). Recent evidence has shown that Qat chewing delays gastric emptying of a semi-solid meal, probably as a result of the inhibitory action of cathinone in Qat (*Heymann et al.*, 1995). Delayed stomach emptying may contribute to increased rate of gastro-oesophageal reflux manifested as heartburn and acid regurgitation, and to increased risk of cancer of the oesophagus.

Anorexia frequently follows a Qat session and chewers seldom eat a further significant meal on the same day. A significant reduction of appetite after Qat chewing (Qat-arm) was recently observed as compared to the non-Qat (control arm) of the study (*Hassan et al.*, 2000). This anorectic effect may be attributed to of a combined central and gastric effects of cathinone in fresh leaves of Qat (*Heymann et al.*, 1995).

A common ailment of Qat chewers is constipation, probably caused by the astringent properties of the Qat tannins (*Kalix et al.*, 1985). Habitual users try to attenuate this undesirable effect by food adaptation, notably by eating prior to a Qat session, a meal with high fat content in order to facilitate intestinal transit (*Hughes*, 1973). The constipating effect of Qat was suggested by the observation that when a ban was imposed on Qat in Aden in 1957 the sales of laxatives decreased by 90 percent, but returned to the original level soon after the ban lifted (*Halbach*, 1972). Recent evidence has shown that chewing Qat leaves significantly slows gut movement (both the orocaecal transit time (*Zureikat et al.*, 1992) and the whole gut transit time) (*Gunaid et al.*, 1999). These two mechanisms may contribute to the constipating effect of Qat. Moreover, Qat chewing was found to interfere with absorption of some orally administered antibiotics, particularly ampicillin (*Attef et al.*, 1997). This interesting aspect of Qat effect on absorption of orally administered drugs needs further studies.

(c) Qat and Liver

The liver was suspected by many authors to be particularly vulnerable to negative effects of Qat-use (*Halbach*, 1972 and *Luqman et al.*, 1976). Hepatitis viruses B and C are a cause of major health problems in Yemen. However, in a study conducted in a rural community of Taiz Governorate no significant relationship was found between Hepatitis B virus positivity and Qat use (*El-Sorori*, 1991).

In a recent study on acute sporadic hepatitis in Yemen, it was found that hepatitis viruses types A to E accounted for only 41 percent of hepatitis cases. To a great surprise in 51 percent of cases there was no viral cause. There might be an unknown virus responsible or some environmental toxins, probably the pesticides in Qat leaves (*Gunaid et al.*, 1997).

(d) Qat and the Genitourinary system

One of the obvious side effects of chewing Qat leaves is temporary interference with difficulty in passing urine and poor urine flow. The overall urine flow rates were recently found to be significantly lower in Qat users (*Nasher et al.*, 1995). This effect was probably mediated through stimulation of adrenoceptors (i.e. stimulation of nerve endings) in the bladder neck by the sympathomimetic alkaloid, cathinone. The consumption of Qat is also said to induce an increase in libido, loss of seminal fluid in urine [spermatorrhea] and erectile dysfunction (*Kalix*, 1990).

(e) Qat and Reproductive Health

In the domain of reproductive medicine, epidemiological data derived from 1181 deliveries in Yemen showed that at birth the mean weight of full-term single infants born from mothers who chew Qat habitually or occasionally, was below average (P-value < 0.05) (*Abdul-Ghani et al.*, 1987).

A study on the pregnancy outcome and Qat showed significantly increased incidence of low birth weight full-term infants among the offspring of Qat chewing women during pregnancy in comparison to those who were non-chewers during pregnancy (*Eriksson et al.*, 1991).

Recent evidence indicates that newborn babies of mothers who used to chew Qat during pregnancy had a significant decrease in all neonatal parameters such as birth weight, length, head circumference and vital signs (i.e. respiration, pulse, colour, tone and response to stimulation of the throat) in comparison to those mothers who did not use Qat during pregnancy. This effect was found to increase in severity with the increased frequency and duration of Qat chewing during pregnancy (*Ebd-El-Aziz et al.*, 1996). Results obtained from the studies mentioned above indicate that frequent use of Qat during pregnancy may affect growth of the baby in the uterus. An experimental study in rats has recently proven that Qat can affect intrauterine foetal growth by reducing total foetal fat and weight and by inducing some changes in the chemical composition of foetal organs particularly, liver, heart and kidneys (*Abd-El-Aziz*, 1996). This effect was attributed to a disturbance of nutrition of the baby (depletion of carbohydrate material and suppression of DNA and protein synthesis in foetal organs).

Nursing mothers in Yemen frequently complain about poor lactation. Some authors believe that this phenomenon could be related to the use of Qat; as (+) nor-pseudoephedrine in Qat may inhibit the secretion of milk (*Luqman et al.*, 1976). However, further work is needed on this matter. Interestingly, it was found that the breast milk of Qat chewing mothers contains (+) nor-pseudoephedrine, one of the active ingredients of Qat, and this compound could even be traced in urine of one breast-fed infant (*Kristiansson et al.*, 1987). Clearly, further studies are recommended to elucidate the potential health hazards of this effect.

(f) Qat and Diabetes

The effect of Qat chewing on diabetic patients is still debatable. Moreover, the very few published literature on this issue makes it difficult to draw a conclusive evidence. Some authors believe that the overall effect of Qat on diabetic patients is deleterious, because the user, is less likely to follow dietary advice, and the consumption of sweetened beverages with Qat aggravates high blood sugur (hyperglycaemia) (*Luqman et al.*, 1976). A clinical study was conducted on diabetic patients in Yemen some 20 years ago (*Ramadan et al.*, 1979). It has proven that Qat-extract mixed with glucose tolerance test has significantly lowered the blood glucose level in comparison to control groups of the experiment (controls). They have attributed this effect to delayed absorption from the intestine by the action of Qat tannins and inorganic ions particularly magnesium which produce a substantial inhibitory action upon gastrointestinal function. It seems that Qat-induced delay of gastric emptying of meals (*Heymann et al.*, 1995), may also play a role in reducing blood sugur after a meal (postprandial hyperglycaemia) in patients with type 2 diabetes. On the contrary, a similar study on non-diabetic subjects in Somalia (*Elmi*, 1983), showed that Qat does not influence to any significant extent blood glucose levels in man. Obviously, this is an interesting matter which needs further clarification.

(g) Qat and Cancer

Since Qat use is widespread and often lasts throughout adult life a number of studies have been made on the toxicological aspects of habitual use of Qat.

Owing to its mode of consumption, Qat frequently affects the oral cavity and digestive tract. Its effect was found to be clearly dependent on the level of Qat consumption (Kalix, 1990). Tumours of the oral cavity (lower maxilla, buccal mucosa and tongue) were reported in 0.13 percent of patients seeking treatment over a two-year period in a stomatological clinic in the Yemen town of Hodeidah. Most of them have been habitual Qat chewers for more than 20 years, and some of them were also chewing shamma (ground tobacco) (Makki, 1975). Similar review of oral cancers presenting over a two-year period in Asir region showed a strong circumstantial evidence linking the long-term use of Qat with increased rate of oral malignancies (*Soufi et al.*, 1991).

Tannins in Qat can be harmful to the gutter (oesophagus) (*Drake*, 1988), and may be carcinogenic (*Craddock*, 1993). A recent study in Yemen has shown that oesophageal and gastric carcinoma accounted for 6 percent of all patients who had an upper gastrointestinal endoscopy (183 out of 3064 patients) over a period of one year (*Ginaid et al.*, 1995). The majority of women with carcinoma of the mid-oesophagus was noted, previously only recorded in areas of high prevalence of oesophageal carcinoma. This assumed effect of Qat on increased rate of carcinoma at the lower oesophagus might be related to the Qat-induced delay of gastric emptying with a subsequent increased risk of cancer of the lower part of the oesophagus (*Heymann et al.*, 1995). The effect of chewing Qat on the cells of the upper gastrointestinal tract (mucosal histology) was explored in Yemeni patients presenting with indigestion (dyspepsia) (*El-Guneid et al.*, 1991). Regular daily Qat chewing was not associated with significant effct on the oesophagus. However, mild abnormal growth of cells (dysplasia), and intestinal abnormal cells [metaplasia] at the lower oesophagus were relatively higher in Qat chewers in comparison to non-chewers. Abnormal stomach cells (Gastric-type

mucosa) at the lower end of oesophagus are thought to increase the risk of developing cancer (adenocarcinoma) by 30-125 folds. Although its presence was not related to the intake of Qat, its overall prevalence in Yemeni patients was relatively high

(h) Qat and life Expectency

To our knowledge there is no data available concerning the effect of habitual Qat chewing on the life expectancy of Yemen's population.

However, the demographic data of the Yemeni population (census 1994) indicate that the life expectancy at birth is on average 57.5 years (56.9 years for males and 59.9 years for femals) (Projected Life Expectancy, 1998).

(I) Qat and Hard Drugs

To our knowledge there are no published studies on whether Qat consumption prevents people from taking hard drugs. However, some people claim that it reduces the consumption of hard drugs. However, this matter needs further exploration.

4. Conclusions

Habitual Qat chewing...

- may induce disturbance of mood (anxiety and / or depression, insomnia).
- may aggravate disturbances (hallucination and delusions) in psychotic patients, it may also induce aggressive behaviour and create difficulties in treating these psychotic patients.
- could cause elevation of arterial blood pressure and pulse rate with subsequent cardiovascular risk particularly in hypertensive patients. It may create difficulties in controlling blood pressure.
- seems to be a common cause inflammation of the mouth and hyperacidity (of stomatitis, gastro-oesophageal reflux) and constipation. It may also be associated with increased risk of carcinoma of the mouth and oesophagus.
- may interfere with absorption of some orally administered antibiotics
- may have a toxic effect on the liver, probably as a result of pesticides leading to toxic damage of the liver.
- may be associated with increased risk of low birth weight in infants of Qat chewing pregnant women. It may also be secreted in milk of lactating mothers with potential health hazards on infants.
- has controversial effect on blood glucose levels in diabetic patients.

5. Recommendations

- Increasing public awareness about the potential health hazards of Qat chewing. This can be achieved by integrated efforts of different relevant governmental bodies.
- Supporting the scientific Qat research in different institutions and universities to explore different effects of Qat on public health. This can be achieved in collaboration with the ministries of Agriculture, Public Health and Education.
- Integrating Qat education in the curricula of the basic and secondary schools about the potential health hazards of Qat in our community. This can be prepared by experts from Yemeni universities.
- Disciplinary legislation about the use of pesticides in the agriculture of Qat in view of their harmful effects on human health.

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National Conference on Qat

CONFERENCE DISCUSSION MATERIALS

Second Topic
Environmental Effects of Qat Production and Consumption

Qat and The Environment

by

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Abstract

The production of Qat (*Catha edulis*) has today become an economic priority in many Governorates of Yemen. Various social, economic and health problems are associated with the plant. One of them is the use of pesticides in Qat Agriculture. Such substances used in Yemen, still include many of the banned or restricted pesticides. The risk assessment of Qat chewing reveals the hazards of both acute and long–term exposure to the Qat (whether cultivated by the use of hazardous pesticides use or without it). The present study will summarize the different problems of conventional pesticides in Yemen's environment.

A survey has been carried out to record the conventional pesticides widely used in the plant protection activities in Yemen during the last years. The data concerning the imported pesticides and the obsolete stocks, which were disposed out of Yemen, are shown in detail. The types of environmental hazards and adverse health effects are tabulated covering the conventional pesticides, particularly the compounds which were banned or under extremely restricted use in the industrial countries.

A great impetus has been given to biological insecticides as alternatives to chemical pesticides for controlling some agricultural and public health disease vectors, that are harmful to men and animals. Among the available biological control agents are many species of parasitoids, predators and insects pathogens. Moreover, the integration of both biological and chemical insecticides is one way of minimizing the environmental effects of chemical insecticide residues. New data is presented on the results of testing extracts of three plants collected from Yemen and will be evaluated for their insecticidal activity against some common insects in Yemen . These natural substitutes are expected to be as potent as the synthetic ones, but will have the advantage to reduce the cost of pest control and to be less hazardous to human health and the environment.

The main objective of this paper is to identify some factors affecting the protection of Qat trees: The most important of these is the lack of technical knowledge in pest control among Qat farmers. Qat farmers may use many kinds of pesticides with various rates of application for the same pesticide. Neighboring Qat farmers are usually the source of information in pest control.

Awareness campaigns are therefore urgently needed. This paper sums up the most important measures to counter the pesticide problem, in the hope that it may serve as a useful tool for implementing a new policy in which Qat is no longer an encouraged and acceptable social habit. This might eventually help health officers, educators, the media and Qat growers to revise their Qat philosophy.

I. Background to the Problem

A. Qat Production in Yemen

In many regions of Yemen the cultivation of Qat is the predominant form of agricultural. In Sana'a Governorate alone, 37715 hectars or 38.6 percent of the arable land are cultivated with Qat (see table 1). Also in the Governorates of Ibb and Hajja, Qat cultivation is considerable with 16.9 and 15.1 percents respectively. For the low,

dry coastal and desert Governorates such as Al-Jauf, Abyan, Hodeidah, , and Shabwa the figures are with 1.0, 0.6 % , 0.2% and 0.1% respectively, much lower. In these Governorates only in some areas above 1200m above sea level Qat can be grown.

Table 1: Qat Area by Governorate

Governorate	Qat Area in 1989 (in Ha.)	% of Total Arable Land in 1989	Qat Area in 1998 (in Ha.)	% of Total Arable Land in 1998
Sana'a	29243	38.4	37715	38.6
Ibb	12914	16.9	15854	16.2
Hajjah	11477	15.1	14594	14.9
Dhamar	6472	8.5	8263	8.4
Sa'ada	3722	4.9	4952	5.1
Al-Beidha	3535	4.6	4632	4.7
Al-Mehaouit.	3130	4.1	4275	4.4
Taiz	1833	2.5	2318	2.3
Mareb	1345	1.8	1659	1.7
Lahj	1290	1.7	1716	1.8
Al-Jauf	376	0.5	931	1.0
Hodiedah	440	0.6	547	0.6
Abyan	162	0.2	175	0.2
Shabwa	120	0.1	141	0.1
Total	**76059**	**100.00**	**97772**	**100.00**

Sources: Ministry of Planning and Development (1999), Central Statistical Organization Yearbook (1998, p.63), Agricultural Survey for southern governorates (1985), and Agriculture Survey for the northern governorates (1989).

Al-Hubaishi and *Abdel-Kader* (1991) report that more than 60 percent of the scarce arable farmland is used for Qat cultivation. This is at the expense of other cash crops and food production [e.g. coffee, tobacco, sesame, oranges and grapes (table 2)].

Due to the high economic importance of Qat as a cash crop, Qat farmers tend to use pesticides and fertilizers heavily on Qat trees in order to protect them from pests and to ensure healthy foilage. Also the price for Qat is related to pesticide use. With an increase in prices for the leaves, farmers have more incentives to increase the use of pesticides hoping to increase the yield and thus their income.

Table 2:Development of Cash Crops and Fruit Trees In Yemen (1990–1995)

Crops	1990		1995		Relative Growth in %
	Area (in ha.)	%	Area (in ha)	%	
Cotton	10369	7.6	12860	8.0	4.4
Tobacco	3706	2.17	4046	2.5	1.8
Coffee	24804	18.2	27347	17.1	2.0
Sesame	8577	13.6	23104	14.1	4.5
Qat	**79020**	**57.9**	**92662**	**57.9**	**3.2**
Oranges	5651	3.5	11714	6.0	15.7
Grapes	17106	10.5	21106	10.8	4.3
Other Trees	35818	22.0	42242	21.6	3.3

Source: Ministry of Planning and Development; Republic of Yemen, Central Statistical Organization, Yearbook 1996 (for 1995) p.62.

B. Pesticide Imports

Table 3 lists the amounts of pesticides used in the northern, southern and eastern Governorates of Yemen. It becomes clear that the northern Governorates, where also most of Qat is grown (see table 1) are the main users of imported pesticides. This also illustrates that the amount which is being spent on pesticides has been steadily increasing in recent years. In 1998 a total of 2305 tons of pesticides was imported to Yemen (*CSO*, 1998), as compared to 650.7 tons in 1989.

Table 3: Amount and Price of Imported Pesticides in the years 1989–1992

Year	Northern Governorates		Southern & Eastern Governorates		Total	
	Tons	mio. YR	Tons	mio. YR	Tons	mio. YR
1989	343.7	6.6	307	11.8	650.7	18.4
1990	191.3	7.3	167.5	6.51.3	358.8	13.8
1991	398.6	27.8	280.3	3.1	678.9	29.1
1992	610.9	46.6	41.8		652.7	49.7
Total	**1544.5**	**88.3**	**796.6**	**22.7**	**2341.1**	**111**

Source: Annual Report Tihama Development Authority 1996.

The amount of imported insecticides and fungicides more than doubled between 1993 and 1998 (see table 4). This continuous increase in imported pesticides includes those used on Qat plants. Although there is are no official records on the development on qat area and its correlation with the rising amount of pesticide

imports, it is evident that there is a close relationship between the two. In 1989 a total of 650.7 tons of pesticides were imported by Yemen at a cost of 18.4 million YR. By 1997 imports had risen to 690 tons at a cost of $ 9.4 million (1504 Million YR).

Table 4:Yemeni Pesticides Imported from 1993–1998 (in metric tons)

Year	Insecticides	Fungicides	Total Metric tons
1993	498	87	585
1994	264	184	448
1995	338	20	358
1996	809	145	954
1997	600	90	690
1998	1148	120	1268*
Total	**3657**	**646**	**4303**

Source: First Workshop on Plant Protection and Production, Ministry of Agriculture (Tihama 1994); Annual Report Tihama Development Authority, 1996; Al–Ghashm and Nasher, 1999.

* The Ministry of Agriculture puts the amount of pesticides imported in 1998 to 1268 metric tons. CSO, however, reports 2305 tons (statistical year book).

C. Fertilizer Imports

In Yemen fertilizers are widely applied to the soil in order to promote Qat growth and enhance productivity. These products can, however, find their way into the ground water system and disturb the ecological balance. Nitrates pollute this valuable resource and affect the quality of drinking water and thus increase specific health hazards. Most of the adverse effects of fertilizers result from inadequate knowledge among farmers (e.g. choice of fertilizer and combination of nutrients, rate, method and timing of application, irrigation and water management) .

As pesticides, also the amount of fertilizer imports has risen considerably in past years (see table 5). In 1998 a total of 333.4 tons of fertilizers was imported to Yemen (*CSO*, 1998).

Table 5:Amount of imported Fertilizers during 1991-1994 (in Metric tons)

Year	1991	1992	1993	1994
Fluid Fertilizers	83575	70296	54459	59200
Liquid Fertilizers	34	21	12	39
Total	**83609**	**70317**	**54471**	**59239**

Source: Environment Protection Council (EPC) Report 1995, p. 59.

II. Identifying Some Factors Affecting Pests Control on Qat Trees

In 1999 a questionnaire on pesticides, fungicides and fertilizers was distributed among 150 farmers in different Governorates of Yemen. Results showed that it is usually neighboring Qat farmers who are the sources of information on pest control. The study also revealed that Qat farmers are more knowledgeable in controlling insects than fungi.

Qat farmers use many different kinds of pesticides as well as some fertilizers, with great variations from farm to farm in rate of application for the same pesticides against the same pests. This reflects the lack of technical knowledge in pests control among Qat farmers. The majority of farmers used a single pesticide in each application, but in other cases mixtures of two or more pesticides were used. Most of the pesticides used are insecticides followed by a number of fungicides.

The disturbing fact is that the study documented that some of the globally banned pesticides, such as DDT, Lindane and Parathion were used. It is clear that these compounds entered Yemen's markets illegally. In addition to these, some of the extremely hazardous pesticides, such as the insecticides Monocratophos and Methomyl (group I (A) or I (B) according to the WHO pesticide classification) were found to be used by Yemeni farmers. WHO reglementations outlaw, these substances in the production of food or other edible products, such as Qat leaves. The number of pesticide applications found in Qat cultivation per season was monthly in the majority of farms. The kinds of pesticides applied as well as the number of applications strongly varried from farm to farm. The Average period between the last application of pesticides and Qat harvesting was found to be seven days. In some cases it was as little as 2-3 days.The age of farmers spraying pesticides was found to be 15-55 years. About two thirds of Qat farmers did not know what kind of pesticides they were using.

Consequently, pesticides are not used at the proper time. Often enough the wrong substance is used for controlling insects or fungi in Qat trees. These facts illustrate the high risk for the Qat farmers and Qat consumers (*Thabet*, 1999).

III. Hazards of Pesticides and Fertilizers for the Environment

A Persistence of Pesticides in the Environment

For more than 50 years, attempts to control pests with chemicals achieved only limited and often disappointing success. However, Mueller's discovery of DDT in 1939 and the subsequent development of this potent insecticide in the 1940s led to its wide-scale use in agriculture and public health. Subsequently, it was used widely to control Malaria-carrying mosquitoes and other insect vectors.

A number of chlorinated hydrocarbon insecticides, such as DDT, BHC, chlordane, dieldrin, and heptachlor are generally stable and remain in the soil for long periods of time (see table 6).

Table 6: General Persistence of Chlorinated Hydrocarbon Insecticides in Soils

Pesticide	95% disappearance (average of years) (after *Edwards*, 1973)	75-100% disappearance (average of years) (after *Kearny et al.*, 1969)
Aldrin	1-6 (3)	3
Chlordane	3-5 (4)	5
DDT	4-30 (10)	4
Dieldrin	5-25 (8)	3
Heptachlor	3-5 (3.5)	2
Lindane	3-10 (6.5)	3
Eldrin	2-4 (4)	-

The concerns about the potential threats of pesticides to human health and the environment must be viewed as serious. Aquatic life forms were acutely affected at low concentrations and both chronic and acute effects were associated with biological magnification in food chains. Some of the insecticides, however, are quite toxic to both mammals and aquatic organisms (*Stewart* and *Gaul* 1977). These synthetic pesticides particularly the organo-chlorine pesticides were banned in the early 1970s in most developed and industrial countries. They however are continued to be used in many developing countries including Yemen Republic. This explains the immediate need to ban these hazardous compounds. Regulations controlling their use are desirable for the future. But even if put under control today, we will continue to suffer from the hazardous impact of the residues of these compounds, which are still detected as pollutants in soil and ground water (*Zhao et al.* , 1999).

There are no comprehensive studies in Yemen concerning the persistence of pesticides in Yemen's environment *Dou Abul & al-Shiwafi* (1999) reported that organo-chlorine pesticides and BCPs residues in the coastal sediments collected from the Red Sea and Gulf of Aden, were below the detection limit.

Table7: Amount Disposed of Absolute Pesticides Stocks in Yemen

Governorate	No. of packages	Total weight (tons)	%	Soil polluted with pesticide		Chlorinated pesticides		Other pesticides		Empty Vials of pesticides	
				Ton	%	Ton	%	Ton	%	Ton	%
Sana'a	954	24.33	9.2	1.70	7.0	-	-	18.7	77.0	3.93	16.2
Hadramaut	74	10.03	3.8	0.17	1.7	5.68	56.6	4.16	41.4	0.03	0.3
Lahej	306	28.32	10.7	6.21	21.9	-	-	21.8	77.0	0.31	1.1
Ta'iz	159	20.21	7.7	1.08	5.3	-	-	18.1	89.6	1.03	5.1
Hodeidah	1280	175.40	66.4	73.80	42.1	52.6	30.0	40.7	23.2	8.3	4.7
Abiyan	109	5.72	2.2	-	-	1.8	31.5	3.44	60.1	0.48	8.4
Total	2882	264.01		82.96		60.08		106.9		14.08	

Source: First Workshop on Plant Protection and Production. Tihama 1994; Annual Report, Tihama Development Authority, 1996.

Table 7 shows the amounts of absolute pesticide stocks that were stored without use and were recently disposed. The Chlorinated pesticides in table 7 include DDT , Lindane, Aldrin, Dieldrin, Endrin , Heptachlor and Chlordane.

The unscientific use of pesticides and some fertilizers, especially on Qat is one of the great dangers threatening human health and environment in Yemen. Reports indicate certain types of harmful effects to male and female consumers, such as incidents of acute poisoning and chronic cytotoxicity. These included cases of fetotoxicity and teratogenecity. Also the joint effects of the pesticide residues with khatamines are expected to exert increased synergistic hazards to Qat consumers.

Intensive agricultural production has consumed an increasing amount of nitrogen-based fertilizers, particularly with Qat and other row crops. Nitrite is formedfrom nitrate by certain microorganisms in soil and water. High levels of nitrite in humans cause Methemoglobinemia. It results in difficulties in the oxygen transport system of the blood.

A more recent concern is the production of nitrosamines in food by the reaction of nitrite with the secondary amines. Other initroso compounds can result from the analogous reaction of nitrites with amids, ureas, carbamate insecticides and other nitrogenos compounds. Nitrosamines have been shown to produce liver damage, and hemorrhagic lung lesions in rats (*Health & Magee* 1962). The various forms of cancer for which the environmental N-nitroso compounds are suspected to play a causative role occurred after long latency periods.

B. Hazards of Plastic Waste on The Environment

In recent years a number of halogenated aromatic compounds have engendered increasing concern about their effects as environmental pollutants. The polychlorinated biphenyls (PCBs) have appeared as ubiquitous contaminants of soil and water. They are very stable materials and exceptionally persistent in the environment, even more than the chlorinated hydrocarbon insecticides. The diversity of their usage patterns, the large quantities used, and their stability have led to widespread occurrence of these compounds in soil and water.

The total of polymerization and co-polymerization products which have been imported to Yemen during 1998 reached 43,105 tons (*CSO*, 1998).

Ahmed Bawazeer and *Amin Bawazeer* (1999) report that some 31,044,000 plastic bags are being marketed every day in Aden city alone. Qat is a major contributor to this, since merchants wrap the Qat leaves into colored plastic bags in order to keep the leaves fresh and protect them from drying out Dumping or burning PBC-containing materials, such as plastic bags, is both, environmentally and economically undesirable. The health effects of PCBs are well established. Investigations have shown that PCBs interfere with reproduction in phytoplankters (*Masser et al.* 1972). Other observed effects in mammals and birds include microsomal enzyme induction, porphyrogenic action, estrogenic activity and immunosuppression (*Bitman* 1972 and *Vos* 1972). Such examples of PCBs pollution have occurred in spite of efforts to restrict and eventually eliminate the release of such materials into the environment.

C. Widespread Pest Resistance to Pesticides

With the rapid development of new pesticides in the last three decades, the problem of resistance became a serious and rapidly growing challenge. Even more serious is the multi–resistance of houseflies and malaria mosquitoes to DDT and its analogues (*Georghiou* and *Taylor* 1976). According to *Georghiou* (1990) and *LeBaron* (1991) there are more than 500 species of arthropod pests, more than 100 grass and broadleaf weeds, 5 species of rodents, and at least 100 species of plant pathogens and nematodes that are resistant to one or more pesticides.

Insecticide resistance is generally the a result of extensive use of insecticides. The most simple way to prevent resistance is minimizing insecticide applications. In Yemen, such an example for pesticide resistance, are the field strains of the brown bark aphid *Pterochloroides persicae* [Cholodkovsky]. The resistance ratios of some insecticides were assayed against the adult stage of the susceptible insects and field strains of the brown bark aphid collected from five Governorates in Yemen. The results revealed that all field strains, except the Ibb strain, exhibited high resistance to the recommended organophosphorus and crabamate insecticides. The pyrethroid cypermethrin was effective against the strains of Ibb and Taiz, while high and moderate levels of resistance were indicated in the other field strains. The field strains were, however, sensitive to newly introduced insecticides, methomyl, fenpropathrin and imidalopride.

The results suggest that the number of applications of dimethoate, primiphos – methyl, diazinon and salut insecticides should be limited in Ibb as well as cypermethrin in Ibb and Taiz Governorates to avoid increasing resistance to these insecticides.

This is, however, an unlikely scenario for Yemen. The only hope to overcome the brown bark aphid problem in Yemen seems to be a state run integrated pest management. This could help to save expenses, minimize pollution, and safe predators and parasites to recover in order to obtain the natural balance in the field (*Thabet*, 1999).

IV. Hazards of Pesticide Residues in Qat Leaves on Consumers

A. Interaction with Enzymes and Effects of Qat Extracts Contaminated with Pesticides

The serum cholinostrase activity and the levels of chronic exposure to pesticides were measured in mices . There was a decrease in the activity of serum (AchE) and the exposure index indicated high chronic exposure level among the qat farmers and consumers (a*l-Hadrani & Thabet*, 1999).

Combination of pesticide residues with qat is one of the sources of additional hazards to qat consumers. It can interfere with the normal levels and functions of neurotransmitters and their effects on the heart and peripheral nerves (*Thabet*,1993).

The author studied the effects of qat extracts contaminated with pesticide residues on the fetuses of pregnant mice. Results show that qat when combined with sublethal dose of the insecticides Dimethoate or Lindane caused significant growth reduction in mothers weight and more severe reduction in the weight of fetuses as

well as deformations in the skeleton of the fetuses. The reduction in the weight of fetuses was more pronounced than that in the mothers, but in the same order of the relative toxicity.

B. Delayed Neuropathic Effects.

Organophosphours insecticides, which are used on Qat trees cause severely delayed neuropathic effects in the central nervous system (CNS). This type of adverse health effects is irreversible in most cases and there are no antidotes for such toxic hazards.

C. Bioaccumulation of Pesticide Residues and Their Ability to be Transported to Fetuses and New Borns

Many chemicals have low water solubility, but high solubility in nonpolar solvents (lipophilic) and accumulate in the fatty portions of adipose tissues, heart, milk and blood (*Travis et al.*, 1988).

The chemicals found to accumulated in humans are mostly chlorinated hydrocarbons. These are stable and are detectable at very low concentrations.

Kanja et al. (1992) reported that organochlorine pesticides are transferred to fetus and new born babies through placenta and mother's milk. It has been found that the organochlorine compounds transferred in humans from the exposed mother to the fetus and new born include DDT, DDE, DDD, HCH, Aldrin, Dieldrin and Toxaphene.

El-Sebae (1998) indicated that the residues of these pesticides and related toxic chemicals retard in adipose tissues (in mammals) are not kept inert but are slowly released and cause endocrine hormonal disturbance affecting the level of endogenous hormones such as estrogen and thus leading to many biological and biochemical imbalances inducing a chain reaction of cytotoxic and adverse health effects such as immunological depression.

D. Residues and Cytotoxic Effects

Cytotoxic effects including mutagenesis (Mutations are heritable changes produced in the genetic information stored in the DNA of living cells), carcinogenesis (a process encompassing the conversion of normal cells to neoplastic cells (cancer)), and teratogenicity (a result of damage or death of certain cells of a developing organism) were reported for a number of pesticides.

Cancer was considered to be a rare disease in Yemen. However, during the last 15 years, it became a significant health problem. In 1999 *Al-Hadrani et al.* reported that a total of 2750 patient with cancer were diagnosed or treated between 1982 and 1992 in seven northern Yemeni hospitals. All cases were histologically proven cancer. Of these 1388 were diagnosed in males and 1362 in females. Ages ranged from 1 to 75 years. The study showed that lymphomas were the most common malignant tumors in Yemen (12.8%) followed by skin cancer (12%). Other common malignant tumors include stomach (10.7%), esophagus (8.5%) and breast (5.4%) The

most common malignancies among males were lymphoma, stomach, oesophagus and skin malignancies. In females, the most common cancers were female genital tract, lymphoma, breast, oesophagus and stomach cancers. The commonest systems involved were head and neck (27.5%) and the gastrointestinal tract (26.7%). The study also indicated that cancer of the gastric cardia, oesophagus, skin, breast and lymphomas have been increasing during the last decade. This increase in cancer cases might reflect the marked changes that have been taking place in the Yemeni environment particularly the widespread and unsafe use of pesticides in agriculture *Hileman* (1993) reported that recent research points to organochlorines as one possible cause of cancer whose rates are rising. Cancers occurring in excess include multiple myeloma, leukemia, cancers of skin, prostate, brain, pancreas, and kidney. Recently *Allen et. al.* (1997) attributed the increase in breast cancer in Hawaii to the intensive exposure of the Hawaiian environment to heavy use and long term exposure to pesticides and other agrochemicals. *Keller-Byrne et al.* (1997) found positive associations between prostate cancer and farming. The most plausible explanation for this phenomenon is that the exposure to pesticides (either directly during occupational exposure as farm workers or indirectly by intake of contaminated food and water with residues of pesticides) will lead to endocrine disruption leading to increased cancer risks due to hormonal endocrine lesions in the reproductive system. Similarly, *Wilkinson et al.* (1997) investigated the cancer incidence and mortality in the vicinity of a pesticide manufacturing factory. They recorded an excess of skin melanoma, cancer of lung, stomach, and pancreas combined with prostate cancer.

In 1985 the World Health Organization (WHO) and the Environmental Protection Agency (EPA) banned a number of chemicals until then widely used in agriculture. Reason for this measure was the threat they posed to human health (cancer, etc) (see table8).

Table 8: Internationally banned pesticides.

Types of Pesticides			
Insecticides	**Fungicides**	**Acaricides**	**Nematicides**
D.D.T	Captan	Dicofol	Aldicarb
B.H.C	Captafol	Aramite	Fenamiphos
Endrin	Benomyl	Chlorbenzilate	
Aldrin	Thiram	Amitraz	
Dieldrin	Propanit		
Endosulfan	Chloranil		
TEPP	Lindane(B.H.C)		
Pirimicarb	Thiophanate		
Dimethoate	Maneb		
Parathion			
Methidathion			

Of these substances still chlorinated hydrocarbon products (e.g. lindane, etc.) are used in Yemen. This may be responsible for some cases of cancer that occured in recent years in Yemen (al-Hadrani et al. 1999).

This high risk demonstrated in Qat consumers necessitates the public awareness especially between mothers and youngsters to avoid the fatal habit of Qat chewing . it is also the responsibility of the health officers, educators, the media and growers to revise their philosophy and to implement a new policy in which Qat is no longer encouraged as an acceptable social habit.

V. Alternative Pest Control Measures

To void or overcome the health hazards of pesticide residues natural enemies, such as biological control agents (e.g. parasites, predators and pathogens of insects) could be of help. Microbial insecticides, rather than being true chemicals, are naturally occurring microorganisms that can cause disease in target pests. The most commonly used substitute for hazardous synthetic insecticides are bacterial and fungus pathogens.

In Yemen some native plants, such as Neem, Sodom Apple and African Rue which were collected from Abyan, Ta'iz and Sana'a Governorates were tested against some stored grains pests, sucking insects and mosquito (a public health disease vector). The data of this bioassay studies of the plant extracts against tested pests provide that the neem extracts was found to be most toxic among the screened plant extracts against tested pests. All the plant extract appeared to be quite promising for further concerned research with more suitable and affective solvents for extraction of inherent toxic ingredients. The combination of the bacterial pathogen *Bacillus thuringiensis* (H-14) with the sublethal doses of tested pesticides, resulted in additive effects. However, it has been suggested that the bacterial pathogen may have weakened the tested pests sufficiently to make them more susceptible to the tested insecticides. The emerged adults from treated larvae were small in their size and the malformed adults failed to emerge from coccon. The bacterial pathogen reduced the insecticides dosage to a level which would minimize the costs and the hazards of chemical pesticides on human health and Yemen's Environment (*Thabet*, 1990, 1998, 1999 a, 1999 b and 2000).

VI. Recommendations

Government should pay priority attention to the following points:

- A national conferences can help to put the problems of Qat and pesticide residues in the right perspective and hopefully facilitate the work of the Government .
- Great attention must be given by the Ministry of Education Teachers and educators should be well informed and specially prepared to ensure their effective role in the mass campaigns against the use of Qat and pesticide residues.
- Health awareness about the hazards of Qat and pesticide residues must be implemented in our minds since childhood.

- A comprehensive and dynamic program against the use of Qat and pesticide residues must be developed to give all the necessary information on the hazards effects of Qat and pesticide residues.
- Special programs about Qat and pesticide residues problems should be organized in the Mosques and national T.V.
- Improving quality of crop protection research and extension personnel and increasing technical knowledge of licensed pesticide dealers and other pesticide traders through appropriate training, familiarizing with the whole crop protection services and pesticide supply network with existing legislation and principles governing pest management.
- Initiating national awareness campaigns against banned pesticides .
- Evaluation of the toxicity of pesticide residues in Qat leaves and the blood of the consumers.
- Qat farmers must learn how to recognize pests and natural enemies, how fertilizer and irrigation practices affect the pest, how to conserve natural enemies , how to reduce pesticide exposure, and how to optimize investment in Qat protection .
- The extension service should increase its linkage with the source pest and pesticide management information .
- Determination of accurate economic threshold infestation level for each pest.

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National Conference on Qat

CONFERENCE DISCUSSION MATERIALS

Third Topic

Yemen's Society and the Qat Phenomenon

Yemen's Society and the Qat Phenomenon

by

Nooria A. Humud (chapter I), Naget M. Sayem (II), Abdalla A. al-Zalab (III),
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I. The Effects of Qat on Family Life in Yemen

A. Introduction

Those who live in Yemen realize the negative effects of Qat on the social and economic aspects of life. In the absence of channels of recreation and lack of guidance as to the ill effects, Qat has taken hold of the Yemeni family and controlled it in the course of time, so that today life is to a large extent planned by, and adapted to the use of Qat. The consumption of the plant controls all social functions, even marital relations and child upbringing. Qat affects the family budget and spending, so that it is quite comprehensible why *Al-Zubairi*, one of Yemen's heroes has called "Qat, the first Governor of Yemen" (*Al-Zubairi*, 1958).

B. The Mafraj, a Gathering Place for Qat Chewing

Consumption of Qat requires a comfortable and peaceful site and hence the family is absorbed by the preparation of this "*majles*" gathering place, traditionally as well as today. *Murghem* and *Rifaat* (1987) wrote "Whoever builds a house keeps in mind the most important room in the house, the *mafraj*, where Qat is chewed. It has to be located high up in order to provide a good view, with low windows to allow that chewers can look outside without having to get up from their mattresses. Yemeni chewers prefer a several storied house to ensure a beautiful scenery, especially in mountain villages."

Hijazi et al. (1981) wrote: "A large proportion of Yemenis pay great attention to the physical aspect of the *majles* of Qat, it occupies the best spot in the residence, whether it is a flat, villa or palace. It is also decorated and prepared better than the rest of the house. In new buildings, it tends to be more simple than previously" . *Al-Magrami* (1982) stated "The *majles* is usually on the highest floor and faces south as it is the warmest direction. If it is inside the house, it is designed in such a way so that it cannot reveal the rest of the house to the guests. If the entrance of the house is shared, then the guests upon entering and departing use certain phrases so that the house members, especially female members, do not meet with the guests . *Sayem* (1997) wrote "The place of the *majles* is very special for both males and females, the best spot is allocated to it, the mattresses and furniture are given special attention as this is the show place of the family for all important social functions". *Weir* (1985) described it thus "In Sana'a and other cities, there is in each house at least one *majles* for Qat, sometimes another one for females. In rich houses there is a divan or *mafraj* on the highest level or in the garden, a large room that can accommodate the participants in the traditional way. The *mafraj* is furnished with mattresses and hard pillows of a better quality than the rest of the house, depending on the financial state of the owner. The room contains varying qualities of copper or aluminum, large trays in the middle to hold hubble bubbles, incense burners, jugs of cold water, ashtrays and Qat spit containers".

However, despite these exotic, social and soothing effects the *majles* has negative aspects. It has become a means of showing off and of extravagance. Since the decoration of the *mafraj* makes the gap between the rich and poor apparent, it

force many people, who can in reality not afford it, to richly decorate their *mafraj*. Hereby, however, they may aggravate their economic situation. Copying and imitation of *mafraj* decorations may also lead to deepening of differences between families. . In addition, the family spends a lot of time and effort in cleaning, reorganizing and preparing the room after each gathering and in order to prepare it for the next. The amount of garbage and waste which is produced by the chewing sessions has also been a cause for concerns due to its effects for health and environmental.

C. Effects of Qat on Social Life and Family Activity

The dominance of Qat in Yemeni society is revealed at all family occasions, such as weddings, birth, death, and circumcision ceremonies, and the return from the pilgrimage (*hajj*) or other travel (see *Weir* 1997). *Al-Magrami* (1987) writes that Qat is at the core of all family customs. In baby births, it is a gathering occasion forced upon the hostess by her relatives, friends and neighbors, which can extend from 7 to up to 40 days. Sometimes there are even separate gatherings for males at the occasion of child-birth, . *Hijazi et al.* (1981) report that during such ceremonies the rooms in which female Qat gatherings (*tafrita*) take place, are "decorated with beads, flowers and envy-repellents such as *shedhab*".

Sayem (1997) differentiated between "*general*" and "*special*" female Qat gatherings:

"General" chewing sessions, which are traditional phenomenon, involve occasions such as death and wedding, where the number of participants may vary between 20 and 300. At such occasions little personal communication is observed amongst the gathered.

"Special" Qat sessions are a recent development, dating back no more than 10 years. This new phenomenon is associated with the greater spread of Qat consumption in recent years. The number of participants usually ranges here from only about 5-10. In most cases there is a personal relationship amongst the group which is fairly homogenous. Younger married or single women form the greater part of these "special gatherings" and call themselves "group" or "clique" (*shula*) (for factors of why chewing of Qat spreads more and more among young urban women see chapter 2).

It must be said that the invasion of Qat that has occurred at all family occasions, is both attractive and a boring burden. The saying "2 weddings rather than a birth celebration" explains illustrates this nicely, since hosting relatives, friends and neighbors for 40 days from conception to "birth completion" is an exhausting duty. Daily provision of tea, coffee, incense, water, hubble bubble (water pipe) and lately, even sweets can mean a considerable burden to family finances. But also the health of the young mother is at stake, since she is forced to sit in a in a smoke infested room for 3-5 hours a day. Out of fear of the "evil eye" she is unable to go to leave the room to breast-feed the baby, so that the newborn has to be taken to the stuffy, smoke filled gathering room, exposing its fragile organism to the polluted air

D. Qat and the Relations between Husband and Wife

At first sight it seems that Qat furthers socialization within the family and thus improves the relationship between the partners and their children.

The League for Arab Countries, however, found in 1983 that "although Qat may create opportunities for meetings and social relations including work and arbitration, its detrimental effect on the family is so profound that it could destroy relations and hence, outweighs any positive general social relations". This is especially true for the relationship between husband and wife, and the parent-children relationship. According to *Hijzai et al.* (1981) "Qat divides the family into 3 worlds: that of the husband, that of the wife, and that of the children who are neglected for many hours daily".

Also *Al-Raadi* (1992) described this grievance: A Yemeni family is comprised of a group under a common roof, the father goes to work while the mother is busy in the kitchen all morning. In the afternoons, each of them disappears into a separate Qat gathering, while the children are left to themselves and play in the streets. For *Al-Raadi*, a Yemeni home is thus " closer to a sleeping station than to a family dwelling". According to his findings, Qat seems rather to prevent a family visiting its relatives than encouraging it. Qat therefore must be held directly responsible for causing damage to family ties and slowly leading to a change in the structure of Yemen's society, which is until today characterized by the ties within the extended family, the clan and the tribe.

Also *Al-Magrami* (1987) has observed this phenomenon and pointed out that "greater family disintegration occurs if each member chews and resorts to his/her group separating males, females and youths". *Sayem* (1997) found that women usually spend 4-7 hours for preparing themselves for chewing and attending the actual Qat *majles*. Naturally this is time spent away from the family. Women justify this usually by pointing out that their husbands leave them at home alone to join friends for chewing Qat. To avoid being left alone all day, they attend Qat gatherings themselves, leaving in turn their children alone in the streets.".

Basheer et al. (1987) report that after being absent all afternoon and often returning only late at night, husbands return in an either excited or anxious mood. This may even lead to domestic violence so that *Basheer et al.* also found that Qat consumption quickly leads to diminished sexual activity and greater disparity between the sexes". Qat chewing must thus be seen as having numerous negative effects on marital life.

According to *Al-Shargi* (1997) Qat changes marital relations and leads to a neglect of duties, a limitation of the exchange of speech and communication, to an inability to follow each others thoughts, to estrangement, weaker emotional affection and ties amongst family members. Also the traditional habit of Qat chewing within the family itself, of husband and wife alongside each other, has strongly diminished.

There is also anecdotal knowledge that Qat consumption can lead to domestic violence. There are however no studies confirming this issue.

E. The Effect of Qat on Upbringing and Children

In the Qur'an it is stated that "*wealth and children are the essence of life*", (*Surat* 26: *al-Kahf*). Also the philosophical saying "*Tell me about the children of a nation and I shall tell you their past, present and future*" is commonly known. A child transforms into a social being via child rearing in social, economic and educational conditions that ensure physical and emotional balance. Islam has stressed the duty towards our children.

The educator *Imarah* (1998) proclaimed: "God advises you to care for your children". In addition to the physiological needs of childhood he names security, belonging, love, self-respect and self-realization(??) as other basic needs. Many have realized the negative effects of Qat on child rearing, nutrition, recreation, and the need for care and love. *Hijazi et al.* (1981) pointed out "Children cannot find any place to go except the streets, where they become a prey for bad influences. Some of these children are not more than 2 years old and are desperately in the need care".

Al-Raadi (1992) found that "parents do not only neglect their children materially, but also neglect their studies and supervision due to Qat chewing. In other Arab countries, parents spent time helping children study unlike Yemen where Qat occupies them". *Zabara & Sabri* (1997) report that "each parent returns after a Qat chew often depressed and has no time for the child's needs." They state that "some researchers have correlated the high mortality and disability to neglect. Al-Thawra hospital statistics have indicated that child accidents such as cars, poisoning, falling and burning are more frequent in the Qat dominated afternoon and evening hours".

Hummud et al. (1996) wrote that "the Qat chew which demands silence and rest, leads to an avoidance of children for 3 to 5 hours daily".. Each parent goes to his/her gathering while the children stay alone or with an older sibling of not more than 10 years of age (who often enough is need of care himself/herself). According to *Hummud et al.* only the rich can afford a maid (often a foreigner) to look after the children.

Al-Shargi (1997) believes that greater drop-out from school of girls is due to their designation as baby sitters for younger children and due to the lengthy services demanded from them to assist visiting Qat chewers. *Sayem*'s study (1997) had indicated that some mothers do realize the negative effects of Qat on children, such as neglect at home, as well as alienation.

F. Effects of Qat Spending on the Family Budget

According to *Al-Zalab* (1998) several questions arise from the issue of Qat consumption and family budget:

- Why does a person with limited income and thus high family needs, spend so much on Qat, sometimes in excess of the monthly acknowledged salary?
- Is malnutrition which affects many Yemenis due to the waste of income on Qat as *Al-Attar* had suggested?
- What is the position of Qat as one of the consumer elements by the Yemeni family

Qat consumption in many instances represents a social and family problem. It is a financial burden and cuts out a substantial portion of the family budget, especially in

poor families with low income and lack of awareness. Qat as a consumer element, non-nutritional in nature, often overshadows much more important family needs.

Al-Zalab (1998) found that the amount spent by the family on Qat depends on many factors, such as the price of each bundle of Qat leaves, the number of bundles chewed, the number of chews each month, the number of chewers within the family and the family income. He found that 64.5 percent of individual Yemeni chewers spent 150-250 Rial per day on Qat, 32 percent spent 260-450 Rial and in 4.5 percent spending exceeded 450 Rial daily.

In the family budget survey of 1992, it was found that the average spending on Qat per month was 1,090 Rial (i.e. 8.3 percent of average spending on food and goods), exceeded only by cereals and grain with 15.5 percent and meat products with 12.4 percent (*Family Budget Survey*, 1992).

The latest family budget survey of 1998 has shown that average family expenditure on Qat is 3,369 Rial per month (other figures found were YR 2,797 and 4,754/month). Average spending per person is 475 Rial. This is equivalent to 8.6 percent of total spending (see also chapter IV D).

Between the 1992 and 1998 surveys, it was noticed that there has been a relative proportional reduction in spending on Qat and smoking. This could be interpreted as a positive sign. However, this development could also be due to the lowering of real incomes in certain segments of the population, which forces people to reduce spending on luxury goods such as Qat, and concentrate on essential goods.

Bamatraf et al. (1997) found that estimates of spending on Qat differ. It is, however, assumed that an average of 20 percent or more of the individual income is being spent on Qat. The burden this inflicts on the family budget, "may result in seeking other sources of income which may not be legal such as bribes and corruption" (*Bamatraf et al.* 1997). *Zabara* and *Sabri* (1997) state:

> "We must remember that Qat especially amongst the poor cuts a portion of the family budget of up to 50 percent. This reduces the share available for child nutrition and other basic needs. In some cases children are forced to work and are deprived of education"..

Al-Medfaey (1981) found that the portion allocated for basic needs and education is deducted after the Qat budget is set aside. Combined with low income this may lead to hardship for children, who consequently lack basic needs, such as food and clothes, medication and school books (see also *Al-Raadi* 1992). *Al-Medfaey* also assumes that the reason for excessive dowries [of up to US $ 10,000[1]] that have become the rule in Yemen might also be due to the effects of Qat". It is assumed that the wealth that farmers have gained due to Qat cultivation has resulted in a rise of the "bride prices" of their daughters (wedding expenses also often include Qat offerings to the invited guests).

The League of Arab Countries warned in 1983 that parents' Qat consumption may result in school drop outs, since in low income families children of as little as 10 years of age are forced to take up work in order to help supporting their families. They are thus deprived of education.

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[1] Comment by the editor.

Hijazi et al. (1981) report supports these findings. They believe that Qat spending may absorb up to 50 percent of the family budget in low income groups (in higher income families Qat spending is proportionally less). High costs arise from the fact buying good and thus expensive Qat (which is a way to show-off), but also from the large amount of Qat needed to reach an enjoyment level, as well as from other associated expenses (such as tobacco, softdrinks or alcohol). For women "associated expenses" include also clothes and jewelry, which they wear and present in Qat gatherings. Marital arguments are frequent due to excessive female demands that arise from the social pressure of Qat gatherings. According to *Hijazi et al.* the excessive Qat related spending , exercised by males and females alike, is practiced not only to show off and thereby to reassert social culture in front of others. The authors identify this phenomenon as a very dangerous facet of Qat gatherings.

II. Motivating Factors and Changes in Qat Use amongst Women

A. Literature on Qat and Women

Most reviews indicate that women did not chew Qat in the past: *Al-Wasey* (see reference 50) wrote that women used to take coffee in their afternoon gatherings. In a 18th century poem by *Al-Khafanji* (died in 1180 *Hijria*), a women's majles is described without any mention of Qat (quoted in *Al-Hibshi*, 1987).

Even though there are no written accounts on when women started chewing, one can assume that this habit started to spread among them in the 1930s and 40s. *Al-Yahya* (1986), who visited Yemen in 1940 said that some of the ugliest habits amongst women were smoking the hubble bubble and chewing Qat whenever available. *Fayan* (1985) confirms this. He reported that women smoked quite a lot and if their husbands were generous also chewed some Qat. In his book "*Yemen from the Back Door*" *Helfritz* (1985) found Qat chewing a habit prevalent amongst all males, females, and children.

B. Recent Changes and Chewing Motivation

Oppermeir reports in his 1973 study that rural women chewed Qat a lot, depending on their husband's ability to provide it. He attributes the spread of this phenomenon among women also to the recently obtained freedom of visiting friends in the afternoons, taking the children with them. *Makhloof* found in her 1976 Sana'a study that some women carry their own Qat to the chewing sessions. The main reasons they give for chewing are the need cooling off and the desire to rest after an exhausting day (*Makhloof*, 1979).

Kennedy's 1976 study (women represented 45 percent of the sample in Sana'a, Taiz and Hudeidah) found that 34.9 percent of women use Qat excessively as compared to 60.3 percent of men. 23.6 percent use the stimulating leaves only occasionally as compared to 30.4% of men. The study confirms that women now use Qat much more than in the past, and comes to the conclusion the for both, men and women, Qat has today become an integral part of their social and cultural life (*Kennedy*, 1987).

Dionna (1984) reports that women use Qat in smaller quantities and chew less long hours than men. Urban women use Qat more than rural women. *Hijazi et al.* (1981) stressed in a 1981 study that Qat consumption has become more prevalent since the early 1960s. Until recently Qat gatherings were restricted to rich families. Middle and lower class women rarely chewed. Qat gatherings were known among married, divorced or widowed women, but not among simple girls. The proportion of non-chewers in a female *majles* was usually higher than that in a male *majles*. In such gatherings smoking the hubble bubble is quite common amongst chewers and non-chewers. Sometimes cigarettes are smoked as well.

Dorsky (1982) pointed out that in Amran Qat chewing amongst females is socially acceptable and that there is a small number of female chewers there. They, however, do not attend Qat sessions daily

Rashed (1983) found that Qat was restricted to married women and that gatherings varied according to social class, with the lower ones providing the hubble bubble and coffee only, the middle ones adding incense and even providing Qat, while the higher ones are also supplying iced water and drinks, as well as almonds and sultanas

Al-Aswady carried out a study on a sample of Yemeni students in Iraq in 1984. He found that 3.77 percent of the females chewed as compared with 67.69 percent of the males. Some of the major reasons given for chewing were lack of recreational alternatives, abiding by customs, imitation through the socialization process (*Al-Aswady*, 1984).

In his study of a sample of 100 male and the same number of female Sana'a University students in 1987, *Al-Zuby* found that 10 percent of girls chew Qat as compared to 70 percent of boys. He explained the figure for women being so low by the fact that probably many of them did not respond truthfully, because of being ashamed to admit chewing Qat. The major reasons for chewing he found were the fact that Qat consumption helps to stay awake and enhances concentration (*Al-Zuby*, 1987). It would be desirable to carry out a similar study today, 13 years later.

In 1997, *Sayem* carried out a study on Sana'a women (n = 805) and found that 77.3 percent of them chew Qat, 22.7 percent do not. The study found that out of those that chew 45.8 percent use it daily, 2.2 percent chew six times a week, 4.2 percent chew it five times a week, 5.5 percent chew it four times a week, 10.6 percent chew three times a week, 14.5 percent chew twice a week, 15.6 percent use it once a week, and the remaining 1.6 percent less than once a week.

Some of the motives for chewing that *Sayem* found were: to attend a social duty i.e. wedding, to socialize, for recreation, due to absence of alternatives, to uphold customs, to have a rest after an exhausting day, and to attend gatherings which are an essential part of Yemeni life (*Sayem*, 1997).

The above shows, that Qat, as *Al-Zalab* (1998) put it, is no longer is no longer a male emblem, as it was traditionally. It has entered the women's sphere.

However, not in all areas of Yemen women are chewing Qat. *Weir* (1985) found that in Rzah (Sa'ada Governorate) women do not chew Qat and drink tea or coffee instead. Also in the area of Sa'ada in northern Yemen, chewing among women is not found and considered to be shameful (*'aib*).

It seems unlikely that qat chewing among women is due to a deterioration of traditional values or bad influence of any kind on young people. There is however a need to conduct further studies on the phenomenon of young women's qat chewing.

When summing up the above, it becomes clear:

- that qat is becoming part of Yemen's cultural and social life.
- that compared to the past, women obtained more freedom (they were not allowed before to visit their female friends.
- that there is a lack of other leisure opportunities.

C. Children's Initiation to Qat Chewing

Oppermeir (1973) found that although children do not attend Qat gatherings, they are in close proximity and closely observe the adults. Thus, it becomes natural to imitate. Use of Qat amongst male children is more common than among female children. Among girls chewing starts at the age of 12 or even a little earlier (*Al-Zalab*, 1998) whereas among boys it already starts between 6-7 years of age. The reason for this might be found in the fathers' encouragement writes *Al-Magrami* (1982), who found Qat use to be deeply rooted in the socialization process and in Yemeni customs. He believes that children's imitation of adults is a part of an initiation process towards adulthood.

Muharam writes in a 1997 study that 15-20 percent of children below the age of 15 are using Qat in Yemen. *Al-Zalab* found in his 1998 Sana'a study that 16.5 percent of the Qat chewers in his sample were between 12-16 years of age. This indicates the dominance of social values on Qat chewing, since attendance implies the transfer from childhood to adulthood. Fathers seem to boast about it as they hand the younger one the Qat branch that will lead him to manhood (*Al-Zalab*, 1998).

III. Qat and Culture

The phenomenon of chewing Qat is one of Yemen's social and cultural characteristics, and in part without doubt a reaction on the transformations which have taken hold of Yemen in the past decades. However, chewing has since centuries been an integral part of daily live. *Varisco* (1986) believes that Yemenis consider Qat chewing and attending Qat gatherings, as a preservation of the cultural heritage, and at the same time as an expression of their own personality and culture.

Al-Magramy (1987) shares this view when he says "especially in local communities Qat forms an integrated culture that aims to stabilize community life". According to *Al-Zalab* (1998) the definition of "Qat culture" refers to:

> "all meanings and issues that Yemeni culture associates with Qat use. This is the outcome of a long historical experience and by no means merely the result of modern day transformations. All behaviors associated with Qat have traditional and social legitimacy, and are not unacceptable, sporadic or individual behaviors."

Although the majority of Yemeni adults use Qat regularly, the reasons for this attraction to Qat are not very clear. Researchers who tried to clarify the mystery have not produced convincing answers. One of the reasons for this is the neglect of cultural factors, which are more difficult to verify than psychological ones.

One of the few researchers who was interested in the cultural aspects of the Qat phenomenon is *al-Magramy* (1987) who claims that Qat holds prominent position in Yemeni culture since it is not forbidden by Shariah and Islam.

Western anthropologists have analyzed the socio-cultural aspects of Qat in order to understand other cultures. The place they assigned to Qat in their writings was that of an axis of Yemeni life. *Kennedy* (1987) after two years of fieldwork concluded that studying Qat is an arduous and complicated issue because it involves so many intertwined factors of social and personal issues. What helped these anthropological studies was the practical experience of living within Yemeni society and the fact that the researchers themselves used Qat.

A. Effect of Qat on Yemen's Creative and Cultural Scene

Qat chewing sessions in their present form, have become a substitute for cultural centers, educational establishments, and places of entertainment. They have become a place of communication between individuals and groups, and they represent in many towns and villages of present day Yemen the only place of exchange. *Al-Magramy* writes that "Qat gatherings in Yemen worthily occupy the place of the literary forum, the club, the theater, the cinema ..." (*al-Magramy*, 1987).

It is obvious that Yemeni intellectuals found the Qat sessions to be a suitable place for their meetings instead of the cafes which are not abundant in Yemen today, or the popular salons known from other Arab countries. If such places are found in Yemen, they are a mere place of food and drink, but are never used for gatherings or meetings.

Lambert compares the Qat gatherings of Yemen with the European "salons" of the nineteenth century. For him Qat gatherings represent a "similar experiment for balancing between private and public life, since Qat gatherings create a specific social familiarity but are still relatively open to outsiders and the public" (*Lambert*, 1990).

The intellectuals' Qat meetings have become cultural symposiums having their own traditions, regulations, and even time schedules. In these meetings various kinds of cultural aspects of Yemeni life are presented, read, discussed, or performed. Novels, articles or poems are recited. And recently also dramas and other theater plays have been performed. Such Qat sessions are referred to as poem- or theater gatherings.

Theatrical performance is not developed in Yemeni society perhaps due to Qat consumption in the afternoons and evenings. As the poet and thinker *Abdallah al-Baraddoony* (1991) put it, "Yemeni society has not been "dramatized" yet, our society is still suffering from the primitive artistic forms" (no theater is existing in Yemen).

Despite this view, the Iraqi theater director *Karim Jathair* maintained that any place is suitable for dramaturgy, even Qat sessions. In the 1990s he decided to take drama into Qat gatherings and exploit them as dramatic or theatrical domain through an artistic experiment known as "gathering theater". This was a unique experience in the Arab world. *Jathair* defended this experiment by saying that "the Qat gatherings create a psychological atmosphere that rises dramatically and ends theatrical. We had found in the Qat gatherings an environment that we consider to be a theater which owns unique characteristics distinguishing it from others" (*Jathair*, 1994). *Jathair* presented many plays in cooperation with Dr. Abdulaziz al-Magalih of the Yemeni

Center for Researches and Studies. These were: *Poster's Play* (Dec. 14, 1993), *The Moon of the Poor* (Jan. 1, 1994), *The Lost Song of Mamaleeks* (April 27, 1994), and the *Night's Traveler* (March 1, 1995).

In the "gathering theaters" the chewers little by little were involved in the show and became part of the presented tale. Whatever the success or failure of this experience was, it showed that Qat gatherings (which are widely held responsible for Yemen's backwardness in many arts and cultural as well as creative activities) can become creative and theatrical platforms. Hence, Qat chewing is not as such a culture-hostile activity and can be integrated in cultural events. But although the Qat majles may encourage some types of cultural activity, it delays others. The reciprocal relationship between Qat and culture is in need of further objective and serious study.

B. Qat and the Preservation of a Traditional Culture

The behavioral patterns and interactions that are found in Qat gatherings reflect the social patterns of Yemeni society as well as the existing social hierarchy. Although the Qat *majles* may give the impression of social equality, the order and place in which the participants sit during a Qat chew follows a strict social system and has a deep meaning in Yemeni culture. It reflects the social status of each participant within the community.

Society's distinctive aspects are most prominent in such Qat meetings. Making room for a late comer to the Qat meeting, and the place where it is made, is also a possibility to assure distinction within the group and among its individuals (*Gerholm*, 1977). In addition to the seating order, the exchanging and offering of Qat branches is another meaningful characteristic of such meetings. The amount and quality of Qat given to another participant is an expression of esteem and social status. It is also interesting to note that the offering of Qat branches cannot be made from the poor and those of lower status to the *sheiks* and those of higher status. Hence, the *majles* accentuates and even protects the dominant social structures and social classification. The Qat *majles* is thus a mirror of the prevailing social system.

But Qat does not only reflect the social system, it also profoundly influences the structure of Yemeni life. It even shaped the country's architecture. In most towns, especially in Sana'a, traditional building patterns and styles are held up (whether the interior or the outside appearance of the buildings), because they meet the requirements of Qat chewing. It is rare to find a Yemeni house without a *mafraj* (with its mattresses, pillows and tall windows designed to host the Qat gatherings) at the best place of the house. On this phenomenon *al-Zubeiry* wrote: "The Qat tree dictates its will on the building design of villages and towns which leads to an adjustment of residential buildings to the requirements of the magic ecstasy or intoxication of Qat chewing" (*al-Zubeiry*, 1958).

Qat also helped to preserve the traditional nutritional system (especially the lunch meal which meets chewing necessities, because it helps to give a better taste to Qat) and traditional clothing that suits the long hours of *mafraj* sitting. Yemen is not that influenced by western clothing tastes as are many other Arab states. Even if some Yemenis wear this kind of clothing for work purposes, they will soon get rid of it when returning home or when going to a Qat chew. It is quite rare to find a non-traditionally dressed person attending a Qat chew.

By this, Qat gatherings have become one of the most important tools for preserving traditional culture. It is owing to Qat chewing that, despite the quick changes affecting every aspect of daily live, the spread of any new culture is strongly limited in today's Yemen.

C. The New Meanings of Qat Chewing

The dramatic transformations that Yemeni society has undergone in the past decades (introduction of new ideologies and modern technology) have lead some Yemenis to believe that Yemeni identity is endangered and that the unity of society is at stake. In Arab countries like Algeria and Lebanon, these changes have destroyed the traditional societies. But in Yemen, even if the affiliation with tribe and family has become of less importance and individualism has been promoted, the country has been affected in a much less negative way by its exposure to the west that many other Arab states.

Still, Yemenis are required to reconcile and balance between the old and the new, and to face the challenge of transformation. Rejecting the new and remaining in isolation can not be a solution. Yemenis must participate in the changes and shape the world around them according to their needs, accept the positive sides and reject the negative ones.

Also the chewing of Qat itself (which is not widely practiced in any other Arabic cultures) has undergone changes due to the transformation of Yemeni society. It is no longer restricted to *Sufis*, the Islamic mystics, but has become a widespread phenomenon. It no longer has only religious meaning, but is chewed also for its leisure, political and social qualities (*Varisco*, 1986). Thus, Qat chewing has acquired a new purpose in contemporary Yemeni culture and can be practiced by any Yemeni from any social class. The entire society profits from Qat chewing which helps it to preserve its cultural identity. Qat is a means of defending and strengthening group unity.

Seen from this perspective, Qat has acquired an imaginary, mythical power, that can unite people and deepen their relationship. Qat also strengths feelings of national identity and permits the chewers to overcome different tribal, political or family affiliations and socialize not only with peers (*Lambert*,1993). Therefore, Qat has become the unifying symbol of society and a factor of solidarity. *Varisco* (1986) assures that Qat has become an indicator of cultural identity which distinguishes Yemenis from others, as is the case in Israel. There Yemeni Jews who left Yemen in 1948 still today cultivate and chew Qat. This helps them to preserve their identity as *Yemeni* Jews and distinguishes them from other groups.

The recent spread of Qat consumption hasn't been an automatic result of the social transformations, but was an integral part of such transformations. Therefore chewing is likely to increase more and more with the ongoing social changes and the ever more important search for identity and differentiation in this modern world. The Qat phenomenon could thus be described as a mass nostalgia, which helps Yemenis to regularly escape all the changes, perceived as threatening.

Qat gatherings have become a mediator between the past and the present. At the same time they are a means of protecting the past against a threatening future. In Qat gatherings with their traditional setting individuals and the group as a whole get the

feeling that everything is as it always was. *Al-Maqrami* goes even further, he describes Qat gatherings as reactionary intellectual and literature forums "that jealously protect values and fiercely fight the destruction of society" (*al-Maqrami*, 1987).

Concluding, it may be said that Yemenis are not physically addicted to Qat, but that they are subjected to the influence of this plant due to complicated cultural and social factors, caused by a changing environment in which the Qat habit has created a refuge. The recent spread of Qat may also be a kind of escape from the present social problems faced by society. The Qat phenomenon may be an expression of a cultural rejection of alien cultures taking hold of Yemen. When understanding Qat as an essential and steady point of reference in a fast moving world, one can better understand why Yemenis chew Qat to such an extent, often enough bare of any economic logic.

This is also why the Qat phenomenon must be considered as dangerous, since it is not actually related to the bare consumption of a plant material and is not a plain social habit, but is related much more to uncontrollable transformations taking place in Yemeni society today. Addressing the Qat phenomenon successfully therefore means addressing those transformations. The Qat phenomenon must consequently been seen as a phenomenon of a culture in transformation.

IV. The Effect of Qat Chewing on Nutritional Status

A. The Effect of Qat Consumption on Birth Weight

Studies on the effects of Qat chewing on the nutritional status in Yemen are rare, with the exception of those that deal with its effects on birth weight. A study conducted in 1984 (*Abdul Ghani et al.*, 1987) revealed a significant difference in birth weight between the offsprings of users and non-users of Qat ($P<0.001$). Children of non-users (n = 295) had an average birth weight of 2978 $\pm$ 413g (mean + SD) compared to 2857 $\pm$ 423g for the off springs of users (n = 414). Hence, newborns of Qat using mothers are on average 120 grams lighter that those of non-chewing mothers.

This study unfortunately did not distinguish between users and non-users in terms of numbers of low birth weight (LBW) deliveries (= less than 2500g). However, another study registering 1141 consecutive deliveries in 1984, showed that non-users of Qat (n = 427) had significant fewer LBW babies (21.5 percent) compared to occasional users (n = 223) (35 percent) and regular users (n = 391) (27 percent) (*Erikson et al.*, 1991).

In 1995, a study was carried out in Sana'a hospitals which looked into factors held responsible for causing LBW, such as Qat chewing and smoking (*Makki*, 1997). Results showed that 25.4 percent of offspring of 773 Qat using mothers had LBW (less than 2500g) compared to 20 percent of LBW offsprings in 1469 non-Qat using mothers. For cigarette smoking, the rate was 40.1 percent of LBW babies in 27 smoking mothers, compared to 21.4 percent in 2185 non-smoking mothers. In 286 water pipe smoking mothers 27.7 percent of LBW babies were found compared to 21.1 percent among 1974 non-smoking mothers.

Qat chewing as well as smoking have thus a significant effect on the birth weight of babies (P values of less than 0.003 and 0.0006 respectively).

LBW is caused by an inappropriate maternal weight gain during pregnancy. Qat may have a negative effect on such weight gain. A study done on guinea pigs (*Jansson et al.*, 1988) shows that Qat fed animals gained less weight (+19 percent) compared to the control group of the aspen leaves fed animals (+30 percent). Yet, *Jansson et al.* state that the difference does not reach statistical significance.

Anorexia is a well known side effect as well in humans as among Qat fed animals: The amount of food intake of such animals fluctuated during pregnancy, but was lower than the food intake in control animals. As a result, birth weight of the offsprings of Qat fed animals was found to be 7 percent lower than that in the control group.

A study on guinea pigs (*Jansson et al.*, 1987) showed that placental blood flow was reduced by 10 percent and 24 percent at 75 and 180 minutes respectively after Qat feeding. This finding is attributed to (+) norpseudoephedrine, a ingredient of the Qat plant, which has been found in animal urine 3 hours after the end of feeding with Qat leaves. This substance causes a constriction of the blood vessels of uterus and placenta (vasoconstriction in the uteroplacental vessels). This effect can be attributed to the inadequacy of fetus feeding.

B. The Effects of Qat Consumption on Breastfeeding

The effects of Qat on fetus feeding are continued after delivery during the lactation period. Active Qat ingredients, such as the cathine compound (+) norpseudoephedrine, are secreted into breast milk and are thus transferred from lactating mothers to the newborn (traces of these substances have been found in the infants urine). Active (dopaminergic) ingredients of Qat may inhibit the prolactin secretion resulting in decreasing volumes of breast milk. This may be a source of infant malnutrition (*Kristiansson et al.*, 1987).

In addition, smoking which often accompanies Qat chewing, alters the taste of breast milk, which leads to a refusal of the baby to drink. The result of reduced demand is a reduced breast milk supply.[2]

C. Direct Effects

Qat contains different compounds that vary in structure and effectiveness. The first compound discovered was given the name of *cathine* by Fluckiger and Gerock in 1887 (*Kalix*, 1990). The important compounds which stimulate some biological processes and inhibit the functioning of some body organs are a group called Qat alkaloids or *cathamines*. *Cathionone* is the most important member in this group and is mainly found in fresh leaves and has an amphetamine-like effect (*Kalix*, 1981). Among the various effects that Qat ingredients have on the body, there are some that affect nutritional processes.

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[2] Personal communications (Dr. Suzana Brazadova. Associate Professor of Preventive Medicine. Masaryk Uiversity, Czech Republic).

1. Anorectic Effects of Qat (Lack of Appetite)

A well known effect of Qat is the anorectic symptoms it causes (e.g. *Halbach*, 1972). This can be explained by the following mechanisms:

- The elevated secretion of thyroidal hormonethyroxine and triodothrionine as a result of cathamines action (*Islam et al.*, 1990).
- The delayed emptying of gastric contents due to the amphetamine effect on gastrointestinal motion (*Heymann et al.*, 1995).
- The astringent effect of tannins and sympathomimetic effect of Qat alkaloids and the reduced motility of intestines which all lead to inability to drive gases away from the body in normal rates resulting to a sense of flatulence (Kalix, 1985 & 1990).

2. Effect of Qat on Digestion and Absorption

Digestion is achieved by two main ways: the first is mechanical (motility of the gastrointestinal tract), the second is a chemical (acids and catalyzed enzymes decompose nutrients to smaller units). The effects of Qat on digestion are:

- Reduction of the motility of the gastrointestinal tract due to the sympathomimetric effect of cathionone (catecholamines are released which stimulate α-adreno receptors) (*Kalix*, 1982).
- Decrease in the acidity of gastric contents due to the flavonal glycoside of Qat (*Al-Meshal et al.*, 1983 and 1985). The decreased acidity decreases the enzymatic activity in the stomach.

The absorption of food is mainly achieved in the small intestines where digestion is completed. There are no studies available on the effect of Qat on absorption efficiency. Known effects of Qat ingredients on the digestive tract include:

- The Effect of tannins (tannic acids) which are polyphonic compounds that bind the gastric contents to form complexes moving slowly to the intestine. Nutrients in these complexes are difficult to be absorbed. This leads to an obstacle in the absorption of saccharides (*Ramadan et al.*, 1979). Tannins also prevent the absorption of iron, especially non-haemiron (*DeMaeyer*, 1989). In fresh Qat an average of about 9 percent of tannins are found (Nahmi and Harazi Qat types have the highest tannin content with 9.7 percent, while Qat from Wadi Dhahar has the lowest tannin level with 3.5 percent (*Bajubair*, 1998).
- The Slowness of Gastrointestinal Motility which may lead to inadequate absorption of nutrients, since absorption is directly proportional to intestinal motility.

3. Effect of Qat on Nutrient Needs and Utilization

Although Qat inhibits digestion and absorption processes, it increases the rate of biological processes that are related to the nutrient metabolism. The human body needs certain amounts of nutrients and energy that vary depending on age, sex, weight, activity, physiological state (such as pregnancy or lactation), etc.

Qat chewing puts the body in an irregular physiological state. Nevertheless, there are no studies on the nutrient and energy requirements for the Qat chewer. However, from available studies on the chemistry of Qat ingredients and their impact on the body, it is quite clear that Qat is increasing the body's needs for energy and nutrients.

3.1 Qat Increases the Basal Metabolic Rate

Carbohydrates and fats are the main nutrients that the body burns (oxidizes) to produce energy. If carbohydrates and fats are not available from food intake, body stores and proteins are used.

The body needs two types of energy. The first is basal metabolic rate (BMR) which is needed to keep the body alive and warm and to build tissues and fluid secretion. BMR is needed, whether the body is sleeping or doing a physical activity. The second is activity energy which is needed by the body for physical activities such as walking, carrying things, and other daily activities. Stored energy (energy currency) is expended as needed, either to build new cells or to carry out physical activity. This process is controlled by many factors, nerval and hormonal and in occurrence, external stimulators such as temperature and the intake of certain substances. The expenditure can be either high (usually in the form of heat) or low as in some illness cases.

The elevation of body temperature due to Qat intake has been described by Drake in 1988 (*Kalix*, 1990). The heat produced is one of the energy forms. This means that part of the energy storage in the body is expended neither for anabolism nor physical activity. This expenditure which reduces the energy storage motivates mitochondria to burn more carbohydrates to produce energy, and because there is no obstacle to absorb saccharides from intestines, energy is produced from the storage of glycogen and fats in the body. This fact is met with the observation of malnutrition among Qat chewers (*Halbach*, 1972).

The process of energy production is accompanied by an increase in breathing rate. In order to provide oxygen required for oxidation, a result of stimulating action (amphetamine action) of Qat on the central nervous system (CNS). This process is also accompanied by increasing the blood pressure and heart rate in order to transfer oxygen (*Brenneisen et al.*, 1990). Elevation of blood sugar levels and thirst also occur. These effects can be referred to the sympathomimetic effects of cathionone on the adrenal medulla that lead to catecholamines (*Murray et al.*, 1993) which increase the heart pulse, vasodilate the arteries of muscles, and increase the oxidation of sugars and fats (*Abdulfattah*, 1983). Another effect of cathionone is that it leads to an elevation of thyroid hormones in the blood which increase the rate of metabolism

3.2. Qat increases Nutrient Destruction

As previously described, carbohydrates are burned due to the effects of Qat through the process of energy production. This process also destroys vitamins, especially those called coenzymes (B complex vitamins) as well as certain mineral elements (*Murray et al.*, 1993). Also the need for certain nutrients, such as iodine is increased for the production of thyroid hormones and tyrosine for the production of both thyroid hormones and catecholamines.

3.3 Nutrient Content of Qat

Qat contains the following amount of nutrients per 100 grams of fresh leaves and twigs: 2.5g protein, 2-7g fibers, 130-160 mg vitamin C, 14.8g niacin, 0.05mg thiamin, 0.05mg riboflavin, 1.8mg beta carotene (300 RE), 7-14 mg magnesium, 290mg calcium, 18.5mg iron (*Bajubair*, 1998).

Even though studies on the body's utilization of Qat nutrients are not available, it is likely that a large portion of Qat nutrients never reaches the digestive system and is thus lost for the body, since the Qat leaves that are chewed are only stored the mouth vowel for some hours, but never swallowed. By the end of the Qat chewing session they are ejaculated.

At a maximum, probably only half the amount of nutrients contained in Qat reach the intestines through the Qat juice, swallowed with saliva. However, the occurrence of these nutrients in intestines does not mean utility for the body. Tannins in Qat inhibit the absorption of minerals and large molecules of nutrients. It should be mentioned that the type of iron in Qat is a non-haemiron (inorganic) which is absorbed in less than 5 percent (*King et al.*, 1992). Even though a high level of vitamin C is found in Qat, which under normal circumstances functions as an enhancer for iron absorption, this process is prevented since iron is found here in complex form with tannins. Therefore, the small amount absorbed of Qat nutrients, particularly B complex vitamins and minerals are not enough, even for the added requirement of metabolic activity which is increased due to Qat.

The amount of vitamin C absorbed is helpful to reduce the dangerous effect of amphetamine, because it helps the body to excrete this dependence producing substance with the urine.

D. Indirect Effects

1. Effect of Household Food Security

Household food security stands for a household's sufficient access to food, with adequacy in terms of quality, quantity, and safety. In 1992, the World Bank estimated that 19 percent of Yemen's population are below the poverty line, which means that their resources are insufficient to meet their basic food and non-food requirements. Due to stagnant economic growth, the World Bank's 1995 poverty estimation shows no improvement compared with the situation in 1992 (*World Bank Study on Children and Women in Yemen*, 1998). Although malnutrition has been determined in the country (*DHS*, 1997), accompanied with inadequate nutrient intake (*World Bank Study on Children and Women in Yemen*, 1998), Qat is still of significant importance for households, also for such below the poverty line in terms of expenditure as shown in the table below.

Table 1: **Relative Expenditure on Food, Qat, Tobacco. Household Budget Surveys 1992 and 1998 (at urban, rural and republic level).**

Item	1992 Survey			1998 Survey		
	Urban	Rural	Republic	Urban	Rural	Republic
Cereals & their Products	10.3	17.1	15.5	8.5	17.2	14.8
Legumes	1.9	1.8	1.8	1.4	1.3	1.3
Vegetables	5.9	4.6	4.9	6	4.6	5
Fruits	2.5	2.3	2.4	2.6	2.9	2.8
Meats, Poultry, Fish, Eggs	14.6	11.7	12.4	10.4	10.3	10.3
Milk and Dairy Products	3.4	3.3	3.3	3.6	5.5	5
Edible Fats and Oils	3.5	4.4	4.2	2.5	5.1	4.4
Sugar & its Products	4.4	5.6	5.3	2.8	5	4.4
Condiments & Spices	1.6	1.3	1.4	3.4	2	2.4
Tea, Coffee, Cocoa	1.8	2.8	2.6	1.1	2.1	1.8
Mineral Water & Soda Drinks	1.1	1	1	1.1	0.8	0.9
Tobacco	3.3	3.2	3.2	2	2.2	2.1
Qat	*9.5*	*7.9*	*8.3*	*8.7*	*8.5*	*8.6*
Other Non-Food Items & Luxuries & Services	36.2	33	33.7	45.9	32.5	36.2
TOTAL	100	100	100	100	100	100

Source: Central Statistical Organization, Household Budget Survey 1996 and 1999.

This table shows the importance of expenditure for Qat which takes third place after meat and cereal products. Expenditure is controlled by two factors: 1) the importance of a commodity or service for the household and 2) the price or the cost of a commodity or service. When comparing the figures for the years 1992 and 1998, it can be noted that many food commodities are affected significantly by an increase in prices.

It becomes clear that unfortunately Qat makes up a large share of the household budget and its consumption thus directly influences the expenditure on food. The table illustrates that in urban areas the expenditure on Qat and tobacco together is higher than that on cereal products. Qat and tobacco take the second place here.

Similar surveys on the household budget in 1977 and 1987 (*CSO*, 1996) show that in Sana'a city the relative importance of expenditure on Qat was at first place, but was replaced in this position in 1992 by meat, poultry, fish and eggs and thus fell to second place. From the above figures it must be assumed that expenditure on Qat consumption negatively affects household food security.

3.3 Effect of Qat Cultivation on Food Production

Qat is planted on 8 percent of the total cultivated area in Yemen and makes up 52 percent are of cash crops (*General Directorate of Agricultural Statistics*, 1999). The table below indicates that Qat occupies the third place of cultivated area and the second if fodder is excluded. The area used for Qat cultivation is larger than that used to cultivate vegetables, fruits, pulses, and other cash crops. In terms of production

output, the quantity (weight) of Qat produced is higher than that of other cash crops. This means:

- Qat occupies a wide area that should be cultivated by food crops to guarantee food security.
- Despite being the most important cash crop in Yemen, Qat is not being exported. Other cash crops which are being exported are produced in comparatively low quantities.
- This immensely affects Yemen's ability to supply its population with food. As a result, rising amounts of food have been imported to Yemen since 1970s, today seriously affecting Yemen's balance of payments.

Table 2: Food and cash crops and their shares in area and production (in percent).

Crops	Area (in %)	Production (in %)
Food Crops	**76**	**58.9**
Cereals	60.2	22.2
Vegetables	4.3	19.9
Fruits	6.6	14.7
Pulses	4.9	2.1
Cash Crops	**15.1**	**4.3**
Coffee	2.6	0.3
Sesame	2.5	0.5
Cotton	1.9	0.6
Tobacco	0.5	0.3
Qat	*7.6*	*2.6*
Fodder	**8.9**	**36.8**
TOTAL	**100**	**100**

Source: General Directorate of Agricultural Statistics, 1999

V. Suggestions, Recommendations and Alternatives

A. General Recommendations

Studies on Qat and its effects on health are abundant. The same is unfortunately not true for scientific research on the social effects of Qat. Promising fields of research would be for example the correlation between:

- Qat and poverty,
- Qat and work efficiency and the neglect of productive efforts
- Qat and family imbalance,

- Qat and Economic hardship.

To determine the significance of these, however, scientific verification is needed.

There is a need for a common international and national stance and understanding:

- When the subject of Qat was raised in the UN in 1965, no decision was reached and different positions were taken by various countries as whether to regard Qat as a harmful drug or not. Today, 35 years later a new international approach to Qat is necessary.

1. Operational Practical Steps

- To address the subject in Yemen, an integrated total plan with a time schedule is necessary.
- It is important to deal with the problem in a unified, cooperative, collective, gradual and total manner, with all parts of society cooperating.
- It is necessary to create an implementation and follow-up body for the chosen plan and strategy.
- It is necessary to establish a national committee or research center that will be responsible for tasks such as follow up and implementation.
- A campaign dealing with Qat profit from experience of similar campaigns addressing smoking and drug problems.
- Questions should be raised as to what has happened in society that has encouraged greater use of Qat, especially amongst females. How do we guide females and prevent children and adolescents from imitating adults, and through what general awareness program?

B. The Role of Legislation and Law

1. Total Prohibition

Studies indicate that attempts to ban Qat in countries where Qat chewing is prevalent have failed:

- banning Qat sales in Somalia in 1921;
- in Kenya Qat was banned for a while in the northern parts of the country;
- importation of Qat into Djibouti from Ethiopia was banned for a while in 1950;
- during the British rule, importation to Aden from Ethiopia was prohibited in 1957 and lifted in 1958;
- in South Yemen during the socialist control, sale was forbidden on week days and limited to weekends,
- in North Yemen in 1972, it was forbidden to grow Qat on government property and government employees were not allowed to consume it at work.

However, in Sudan and Egypt, imports of Qat were totally prohibited as well as its cultivation. These countries succeeded in outlawing Qat as the habit was not prevalent there. In Saudi Arabia, cultivation, sales and use were forbidden in 1971 and were backed by prison sentences of 2-15 years for abusers. The Kingdom was very successful in the eradication of its use.

2. Partial Reduction

Some Yemeni researches have suggested a partial control of the use of Qat (limited to certain places and to certain times) and a reduction of cultivation. Thus:

- Not to allow government employees to take it in places of work as was done earlier,
- Not to allow its use in public places such as cinemas and clubs Not to allow its sale in the main cities.
- Not to allow its sale on streets and small shops and without special permits.
- Provision of compensation for Qat farmers and salespersons who offer alternatives to Qat.
- Allocation of certain days for Qat use, as was done in Aden before unification
- To reduce the sale of Qat to permit holders
- To ban selling of Qat to children and to make a law restricting Qat trade to adults.

3. Taxes

Several authors have suggested a progressive and gradual increase in taxes to reduce Qat consumption.

C. Educational Needs

- There is a need for health education for society (young and old) in order to become aware of the detrimental effects of Qat.
- There is a need to revise school curricula and make Qat a part of them in order to ensure awareness of the negative effects of Qat in the fields of health, economy, culture, nutrition, social and familial issues.
- It is essential to create cultural, rehabilitation, and sports programs targeting adolescents in the Ministries of Culture and Sports & Youth, as well as within organizations of civil society such as the Yemeni Women's Union and the National Women's Council. To achieve this family support centers and training centers that promote other recreational activities should be promoted all over Yemen.
- Public awareness campaigns should be carried out that could be implemented and supervised by the universities and NGOs.
- Awareness campaigns could use methods similar to campaigns that deal with smoking and drug abuse.
- Investors must be encouraged (e.g. by tax advantages) to set up clubs for sports and recreation as well as libraries and family restaurants, gardens and parks where the young can spend the afternoons.

D. Mass Media Involvement

- It is important to design awareness campaigns that will be carried out by the media at various times and on the different negative effects of Qat on society, health and economy (short term and long term campaigns).
- Universities and research centers must cooperate with institutions of mass media by supplying them with suitable material on the negative effects of Qat
- Mass media awareness sources include television, radio, lectures, advertisements, newspapers, sermons, computers, internet and drawings.

- Mass media awareness is not restricted to the Ministry of Information, but involves all other concerned ministries such as that of education, culture, health, sports & youth. The private sector must also participate by establishing and supporting cultural centers, societies, forums, libraries and NGOs.
- Support from policy makers for awareness programs would give them importance.

E. Cultural Alternatives

- Qat chewing is a social activity in Yemeni society. It is not restricted to a certain class or educational group, it is widespread amongst all. Non-involvement in Qat chews can result in social isolation. The Qat majles has a cultural distinctive function of communication, recreation, celebration and relaxation. This makes it clear that alternative socializing factors must be found if campaigns to counter the Qat problem should meet any success.
- One should be aware of the fact that changing cultural habits, attitudes and behaviors is an arduous task and takes time.
- There is a need for finding other venues for recreation for the family as a whole, so that absence of parents is minimal and the neglect of children could be effectively countered.
- The Qat gathering has promoted creative cultural activities such as singing and music. An alternative channel of cultural expression is needed to guarantee the preservation of this enriching aspect.

F. Nutrition

- Provision of information on the nutritional and health effects of Qat on the body, the fetus, and the baby should be distributed to families, doctors, and students.
- The family should be made aware of effects of Qat on food security for family and food production.

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National Conference on Qat

CONFERENCE DISCUSSION MATERIALS

Fourth Topic
Qat in Yemen's Agriculture

Qat and Agriculture

by

Dr. Ismail A. Muharram, Dr. Abdul W. Mukred, and Dr. Ali Noman

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I. Abstract

Despite being introduced to Yemen from Ethiopia thirteenth century, Qat consumption remained until quite recently restricted to the upper segments of Yemens Society. The Socio-economic changes that took place in Yemen in the aftermath of the 26th September revolution in 1962 and the mass migration of Yemenis to the oil rich countries in the mid sixties and early seventies were among the major factors which promoted the expansion and mass consumption of Qat. The developmental changes which took place during this period led to the increase of per capita income from 62 US$ during the 1960s to more than 500 US$ in the 1970s (*Ward et al.* 1998). This significant change in income was mainly attributed to the revenues of immigrants from abroad. In Yemen these immigrant revenues were used for the drilling of wells, the expansion in irrigated agriculture, the construction of houses and for Qat growing. This was a result of non-availability of other venues for investment.

At the end of the twentieth century the expansion of Qat had reached 100,000 ha. in different agro-ecological zones of Yemen, ranging in elevation from 1000 to 2500 meters above sea level. Qat partially replaced coffee in the *wadi* beds. After the drilling of wells and the availability of irrigation water Qat also partially replaced food crops grown under rainfed conditions. Fruit trees were partially replaced by Qat in the plains of the central and northern highlands. Periodical droughts and high cost of production contributed to this partial replacement. There are indications that there is a significant expansion in Qat cultivation on reconstructed or newly constructed terraces as well as on marginal lands, which were range lands and water sheds before rehabilitation.

Qat growing must be seen as a successful investment because of readily available markets for its disposal and the high economic returns compared to the cost of its cultivation. The lack of clear government policy towards Qat contributed to its expansion.

The comparative advantage of Qat is reflected in its high return per unit area and resource use, multiple pickings and marketing throughout the year except during the winter season has made it a unique agriculture crop difficult to compete with. This is true given the existing levels of production and technologies applied.

The future approach to Qat should rely on an integrated strategy aimed at reducing its consumption and development of technologies for alternative crops for possible competition. Qat should also be included in the research and extension agenda. The objectives of research should be:

- collecting more socioeconomic data on its cultivation,
- developing technologies, which might help minimizing the risks of the random use of chemicals,
- rationalizing the use of resources such of water in its cultivation.

II. Material and Method

For the purpose of preparation of this paper a review of available literature was conducted. Areas where there is insufficient or only outdated data were identified and mentioned in the text. The review revealed that most available information is relatively old and goes back to the 1970s and 80s. Available statistics appeared to be conflicting and not accurate.

The review included reports of diagnostic surveys and Rapid Rural appraisals of production systems conducted during the period 1996-1999.

Reviewed topics include reasons for Qat expansion, the benefits of Qat cultivation compared to other crops, crops which were partially or totally replaced by Qat, comparisons between the economics of Qat cultivation and other crops grown in the same areas.

Conclusions on the level of decrease of areas under crops as a result of Qat expansions during the last three decades were made.

The review included information on crops preferred by farmers in Qat growing areas, competitive crops for Qat in the different agro-ecological zones in Yemen were suggested. The review was concluded by highlighting the issue of Qat in the scope of the mid term plan of the national research and extension strategies.

The review of available literature revealed that there is a need for conducting socio-economic investigations in different production systems where Qat is cultivated. These investigations should serve as a database on Qat cultivation, expansion, economic returns at the existing levels of cost of production and prices.

III. Results and Discussion

A. Reasons for the Spread of Qat

Ethiopia is the origin of Qat (*Catha edulis* F.). According to *Tegani & Mahi* (1962) as well as Samarkandi in his book on medicinal plants quoted by *Al-Attar* (1965), the crop was introduced to Yemen in the thirteenth century. Qat was spread after being introduced because of its stimulant effect on those who chew it, Sheikh Maswari who lived at the same period noted that Qat helps researcher and worshippers to perform their tasks in a better way (*Abdul Monem*, 1979). The Yemeni Sufis were the first to appreciate the effect of chewing Qat. Qat from their perspectives was a means for better understanding of the universe and for becoming closer to Allah.

Qat chewing remained restricted to the elite of Yemen, which was comprised of al-Ashraf, al-Sada and the rich business class. This was mainly due to its high prices not affordable by other less fortunate segments of society (*Schopen*, 1979).

The severe taxes applied in the nineteenth century on crop production by the Turks highly affected the cultivation of coffee and forced people to abandon lands and neglect crops to avoid tax paying. This policy was even more severe after the departures of the Turks from Yemen. The situation helped the promotion of Qat cultivation which then was not subjected to taxation, yet (*Al-Shehari*, 1979).

Schopen (1979) stated that Qat chewing became widely popular in Yemen in the early 1870s. Around this time the expansion of Qat cultivation reached Haraz and Hufash. As of the end of the nineteenth century Qat became the most important crop in Yemen and with the beginning of the twentieth century became popular also among the poorest segments of the society. In this process also students and women became introduced to Qat chewing.

The dramatic expansion of Qat cultivation, however, took place after the 26th September revolution in 1962. This was mainly due to emerging markets, the opening of borders, and the rise of migration to oil rich countries. These developments positively

affected the per capita income. The migrant revenues were spent mainly on the purchase of luxury goods, Qat chewing, and the construction of houses. The absence of investment opportunities and government policies aimed at support for a national investment program was one of the reasons for investment in Qat cultivation around this time (*Al-Sadi*, 1983).

The decrease of rainfed and spate irrigated agriculture during the past three decades is considered to be one of the reasons for the expansion of Qat. During the same period a significant shift to market oriented agriculture was made. This shift was based on irrigated agriculture as a result of the drilling of wells. The subsidized policy of agricultural inputs including drilling of wells and pumping equipment and the availability of subsidized food grains in the market contributed positively to expansion of irrigated agriculture.

Muharram (1996) summarized reasons for Qat expansion as follows:

- the absence of a clear policy on Qat,
- the high economic returns of Qat per unit area compared to other crops,
- the tolerance of Qat to drought and low soil fertility,
- the ability of Qat to grow on marginal lands, which helped to reclaim many areas not suitable to grow any other crop.
- the ability of Qat to grow in a wide agro ecological zone ranging in elevation from 1000-2500 m,
- the positive effect of Qat on terrace building and rehabilitation,
- Qat-created labor markets in rural areas, reducing the mass migration to urban centers,
- low cost of production and the limited requirements of Qat for inputs including labor,
- the availability of markets for its disposal throughout the year,
- the availability of a wide range of Qat types with different prices, which satisfy the needs of different segments of the society,
- the fact that Qat can be picked more than once in a year,
- and finally, Qat chewing became a social phenomenon in nearly every village where people gather to discuss, exchange views, and solve problems.

B. Crops Substituted by Qat

Qat is grown in different agro ecological zones ranging in elevations from 1000 to 2500 m. These zones are warm *wadi* beds, plains of mid altitude areas, mountain terraces, and inter mountain plains.

Quantitative data on the level of replacement of other crops by Qat is not available. However, it can be inferred that Qat partially replaced coffee and fruit trees in *wadi* beds. Qat also partially replaced food crops in the mid altitude plains and mountain terraces especially after the massive drilling of wells in these areas. In addition it could be said that Qat partially replaced food crops (sorghum and pulses) and fruits (grape-vines and deciduous fruits) in the plains of the central and northern highlands. The partial replacement is said to be due to the high cost of production of the substituted crops and

the periodical droughts, which occurred, in the early 1980s, which drastically affected fruit trees and vines.

Al-Madfaee (1983) stated that areas under Qat increased during the period of 1973/74 by 11,8 percent compared to 1972/73. This increase is according to *Al-Madfaee* equal to the decrease of areas under sorghum in the same period. Qat was planted on significant range lands in the central and northern highlands. This was mainly because of the high returns of this crop compared to the value of range lands. *Revri* (1983) noted that the cost of production of one ha. under irrigation in 1979/80 was 4500 YR for Qat, 3270 YR for coffee, 4210 YR for grapes, and 1925 YR for maize while the net returns for the same crops and the same period were 2,133,900 YR, 13,150 YR, 16,350 YR, and 2875 YR respectively. Under rainfed conditions the economic return per ha. of Qat is only 35,650 YR. Despite this comparatively low return from Qat, this figure is still much higher than the economic return of other crops under the same conditions. The figures for other crops were 6290 YR for sorghum, 2653 YR for coffee, 8175 YR for grapes and 575 YR for maize.

C. The Contribution of Crops to the Agricultural Production before Qat Expansion and Today

The South East Asia Water Commission (ESCWA) study in 1993 estimated the Qat area in 1990 to exceed the total fruit area by 29 percent and exceed coffee area by three times.

The World Bank (1999) conducted a study on the comparison of indicators of the agricultural sector between 1970 and 1996. The summery of this comparison is shown in the following table:

Table 1: Comparison of Agricultural Sector Indicators between 1970 and 1996

	1970	1996
(1) Shares of Agriculture in the Economy		
Share in the labor force	75%	58%
Share in GDP	45%	15%
Share in exports	-	2%
Shares of land cultivated to: - Cereals - Cash crops - Of which Qat (Tube well irrigated)	 85 % 3 % Less than 1 % 0 %	 61 % 14 % 9 % 32 %
(2)Values		
People employed in Agriculture	1,232,000	1,615,320
Value added to agriculture	240 mn	1,053 mn
(3) Farmed Areas		
- Total cropped area	1,266,000 ha	1,155,000 ha

- Cereals area	1,082, 000 ha	704,000 ha
- Qat area	8,000 ha	91,000 ha
- Fodder area	40,000 ha	94,000 ha
- Fruit and vegetables	39,000 ha	136,000 ha
Rainfed area	1,056,000 ha	579,000 ha
Irrigated area	210,000 ha	488,000 ha
- Spate	120,000 ha	100,000 ha
- Spring	73,000 ha	20,000 ha
- Wells	37,000 ha	368,000 ha
Population per ha	4	13
Number of Farms	-	1,092,830
(4) Livestock		
- Small stock	-	7,2mn
- Cattle	-	1,1mn
% of Agriculture to GDP	-	20%
(5) Production		
- Cereals	845,000 ton	664,000 ton
- Vegetables	25,000 ton	703,000 ton
- Fruits	14,000 ton	79,000 ton
- Qat	35 mn bundles	592 mn bundles

Figures listed in the above table clearly indicate the dramatic changes in Yemen's agriculture. These changes are mainly due to the expansion of irrigated agriculture by the use of underground water resources and the reduction of rainfed agriculture. There is also a significant increase in growing cash crops (fruits, vegetables, fodder) compared to cereals. There is a dramatic increase in Qat area and production.

These changes illustrate the magnitude of change in Yemen's agriculture and the shift from subsistence agriculture to market oriented agriculture. The reduction of springs by 60 percent and the increase of tube wells by 1,043 percent in 1996 compared to 1970 is a clear indication of the level of investment in drilling of wells and the expected effect on water resources.

According to *Al-Hamdi* (1997) quoted by *Ward et al.* (1998), this well drilling and the subsidy of irrigation led to intensive Qat cultivation because of its high return per unit water used.

At the level of the rural households, the field surveys carried out in the major production systems in Sana'a, Hajja, Dhamar, Al-Baidha and Al-Dhaleh concluded that the Qat crop has spread on mountain terraces where rainfall is exceeding 600 mm at the expense of a partial replacement of traditional food crops (*Mukred*, 1998). At the household level Qat is grown in production systems characterized by multiple crops.

These crops constitute the major incomes for the household. However, there are cases of specialized cropping systems in which Qat is the only crop cultivated. In these systems the household depends entirely on the neighboring markets or other agricultural areas for purchase of their food needs.

Expansion of Qat in other areas is predominantly in the vicinity of sources of irrigation.

Interesting to note is that *Ward et al.* (1998) estimated the cost of Qat per unit area, per average number of Qat consumers, and the average number of days devoted for chewing annually. It was found that the cost of Qat sold to consumers in the market place was estimated to be 2 billion US$. In addition, the total cost of Qat produced from the estimated 89,000ha in 1996 and sold at the farm gate price to wholesalers and middle men was estimated to be 640 billion US$ annually.

D. The Level of Reduction in Land Area as a Result of the Shift to Qat Cultivation

The expansion in Qat cultivation took different scenarios depending on the local agro-climatic conditions suitable for Qat cultivation. The expansion took the form of partial replacement of traditional food crops in the southern uplands. Alternatively the expansion took the form of rehabilitation of range lands and destroyed terraces in the central highlands of Dhamar, and the partial reduction of fruit trees and food crops in Sana'a Governorate as well as in Rada'a in the Al-Baidha Governorates. In General it can be stated that the expansion of Qat was always associated with the availability of sources of irrigation especially in areas where rainfall does not exceed 400-500 mm.

The percentage of Qat in the cropping pattern ranges between 30–50 percent (*Saeed Al-Bakri et al.,* 1998) in Sana'a Governorate and 80–90 percent in Rada'a, Dhaleh, Mawea and Jabel Saber (*Noman et al.*, 1999). There are cases where Qat cultivation covered nearly 100 percent of all cropping areas, such as in Dhela'a (Sana'a Governorate) and Shamakh (Hajja Governorate). These extreme cases are also evident in some valleys of Dhaleh Governorate (*Noman et al.*, 1999).

At the household/family level there are no accurate figures on the level of Qat cultivation in the cropping areas of the household (for subsistence purposes) and thus on the level of replacement of traditional field and horticultural crops under the different production systems.

E. Development of Qat Cultivation During the Past Three Decades

Statistics on the development of Qat areas as of the early 1970s are contradictory. The findings of the Japanese mission in 1972 (*Government of Japan, Overseas Technical Cooperation Agency*) indicate that the area of Qat in the early seventies did not exceed 8400 ha.

At the same time data on Qat area in the Planning and Statistics Bureau indicate that area under Qat in 1972 was 43,000 ha. *Schopen* (1983) estimated that areas under Qat cultivation were 178,000 ha. in 1978 and 184,580 ha in the early 1980s. However, statistics of the Ministry of Agriculture and Fisheries indicate that Qat area in 1980 was only 47,000 ha. On the other hand *Revri* (1983) provided estimates of 93,000 ha. in 1982 and *Al-Saadi* (1983) stated that areas under Qat were 91,000 ha. in the early eighties in

the northern governorates only, while the area of Qat in the southern governorates was only 1,818 ha.

Despite this contradictory information there is common agreement that the area under Qat is progressively increasing at an alarming rate. This increase cannot be compared to any other crop expansion in the history of Yemen.

F. The Effect of Expansion of Qat Cultivation on Specific Crops

The effect of Qat expansion on the genetic resources of selected crops is not quantified. However, there are indications that there is some direct and indirect effect on the genetic variability of some endogenous crops in the country. There are indications that the genetic resources of grapes have been deteriorating. *Naipers* indicated that during his visit to Sana'a as a member of the famous scientific mission to Arabia Felix, which took place during the period 1761-1767, he counted about forty varieties and land races of grapes in the markets of Sana'a (*Hansen*, 1962).

However the number of varieties available these days does no exceed twenty. In fact some of these varieties are found in limited number of vines.

The results of field surveys in Yafaa districts in 1989 showed that the number of commercial varieties of coffee is not more than six. Old farmers in Yafaa informed the mission that the number of coffee varieties used to be more some 70 years ago (*Mukred & Eskes* 1989)

The deterioration of genetic resources of fruit trees in coffee growing areas might not be directly related to Qat cultivation. The deterioration might be related to the negligence of farmers and less attention paid to these trees, because of high cost of labor and management compared to Qat. This case is apparent in some locations surveyed in Dhaleh, Yafaa, and Udayn (*Noman et al.*, 1999).

There is evidence of deterioration of genetic resources in cereals. This is mainly because of the decreased importance of these crops in the daily food diet. This situation is more complicated by the aging of experienced farmers and the gradual erosion of endogenous knowledge of traditional agricultural practices and husbandry of food crops. The shift of agriculture from subsistence to market orientation also brought other technologies (*Mukred et al.*, 1998).

Farmers in Hajja reported that since Qat has reduced the extent of cultivation of other crops, many crop varieties that had been planted before have been partially lost. Farmers in the same area of Hajja reported to have been cultivating seven varieties of sorghum several years ago, today they know only two. They are not aware of the consequences such a loss in the biological diversity could have for Yemen's agriculture (in Yemen 5800 varieties of sorghum have been found in the early 1970s (*Noman*, 1999)).

Results of diagnostic surveys carried out in the central, northern and southern uplands clearly indicate that there are severe pest problems reported by farmers on local sorghum varieties. This phenomenon is said to have become evident only recently. It could be inferred that the genetic erosion of local land races and varieties might be responsible for this spread of infection. As a result the yields of sorghum have been reduced by almost 40 percent (*Mukred*, 1996).

A loss of crop varieties could thus have an impact on food security. The remaining varieties might in the long run prove less resistant against drought, pests, or cold than lost varieties might have been.

G. Problems of Crops Preferred by Farmers

Qat is grown in the context of different production systems depending on the agro climatic zones, amount of rainfall, and the elevation above sea level. At the high rainfall areas of the central and southern uplands Qat is grown on supplementary irrigation. In these areas Qat is grown in systems where food crops are grown. In the plains of mid altitude Qat is grown on supplementary irrigation together with cereals, vegetables, and fruits (pomegranates, mangos, ficus, and citrus fruits).

In the warm valleys of the mid altitude areas Qat is grown along with coffee and tropical fruits as well as food crops and fodder species (*Mukred et al.*, 1998).

Analysis of problems of the above-mentioned crops revealed that low yield is the common problem of almost all crops preferred by farmers. This is mainly because of the traditional nature of the cultivation, the spread of pests, the aging of perennial crops without rehabilitation, and the limited use of modern techniques in agricultural production (*al-Bakri et al.* 1996).

> Despite the big differences in the economic return of Qat growing compared to other crops in the cropping pattern of the households, the diversification of crops still remains a dominant feature in the production systems in the majority of areas where Qat is grown. This is however often for subsistance purposes only.

H. Substitute Crops for Qat and their Economic Return

Studies and field surveys carried out in production systems where Qat is grown clearly indicate that there is no single crop that can substitute Qat, given the existing levels of production and technologies applied. Moreover, there is no other crop that can efficiently give high returns to the cost of labor and the cost of water per unit product.

Data presented by *Mathews* quoted by *Ward et al.* (1998) showed that the net return of cultivating Qat ranged between 400,000 YR (3,100 US$) and 600,000 YR (4,700 US$) per hectare at an exchange rate of 160 YR /one US$. The net return of water was found to be 30–40 YR per m^3. The net return to the family labor was 2300-2500 YR/day. *Al-Hamdi*'s calculations quoted by *Ward et al.* (1998) demonstrated that the economic return of Qat cultivation around Sana'a ranged between 2,000–10,000 YR/Libna (44,4 m^2) depending on the quantity and quality of Qat produced. The net return per ha grown with Qat ranged between 400,000–1,800,000 YR in 1997 in the same area (for economic returns of different crops for 1979/80 see also chapter III B).

Despite the fact that every body agrees on the difficulty of finding substitutes for Qat, there is reason to suggest crops, which can be potential competitors with Qat in their economic return or the use of resources.

In the warm *wadis* coffee can be a potential competitor for Qat, given the long history of Yemen in producing high quality coffee. The competition of coffee can be realized if modern techniques in coffee cultivation are introduced and applied commercially. Such techniques include high-density planting (HDP), appropriate pruning systems, correct measures to increase soil fertility and integrated pest management. Needless to say that these interventions should be based on experiments under farmers' conditions and should be based on participatory approaches where farmers play an equal role in the evaluation of new technologies. Mangos are also potential competitors in

wadis if appropriate varieties are introduced with emphasis on dwarf types suitable for canning and fresh consumption. In the plains of mid altitude areas (Dhaleh, Radfan, Musaimeer, Maweah) fruit trees can be promoted with emphasis on improved varieties, high density planting and improved irrigation techniques. On the western slopes of hillsides of the central and northern highlands olives, deciduous fruits and coffee can be potential competitors for Qat if modern agricultural practices such as high density planting, and appropriate measures to retain moisture and improve soil fertility are applied, and if varieties with potential export qualities are planted. In the intermountain plains potatoes, tomatoes and grape vines can be recommended as possible competitors for Qat. Protected agriculture has big potential in growing vegetables for export.

In rainfed areas where Qat is grown the only potential competitors for Qat are the annual food crops if improved varieties resistant to biotic and a-biotic stresses are introduced. Local varieties of fruit trees, which are known to be drought tolerant, can be promoted if early maturing varieties and species are introduced.

The different scenarios mentioned above require in depth study and on farm tests with direct participation of farmers in the assessment and evaluation of interventions.

IV. Research Plans and Issues that AREA should concentrate on

Qat was not included in the research and extension agenda of government organizations in Yemen. Development efforts overlooked Qat throughout the recent history of development projects. Similarly official statistics tended to give vague indications about areas, economic returns of Qat and the contribution of Qat to the GDP of Yemen.

As of the mid 1990s the Government could not continue neglecting Qat any more. The realities of the continuous expansions of Qat reaching approximately 90,000 ha in the beginning of the 1990s and the fact that Qat is consuming nearly 25 percent of the underground water became priorities in the Government agenda. In 1997, the Ministry of Agriculture and Irrigation (MAI) gave instructions to AREA to establish a unit for Qat research. The newly formulated research and extension strategy clearly highlighted the importance of Qat in the research and extension agenda under different production systems. The strategy also highlighted the role of Qat in the economics of the households and the dangers of the continuous random use of chemicals in its cultivation. These issues were part of the priorities of the newly established Qat research unit.

The research and extension strategy highlighted the following issues in Qat research and extension.

i) Create a database on Qat in agriculture.

ii) Support of the Qat research unit and gradually transfer it into a national research center.

iii) Conduct socio-economic studies and field diagnostic surveys of the major production systems in Qat growing areas to collect quantitative and qualitative data on the economics of Qat in these production systems and the role of Qat in the economics of the rural households.

iv) Identify technical and knowledge gaps in Qat cultivation in areas such as:

The effect of Qat on the use of water resources and the potential solutions for improving the sustainable use of these resources.

- The level of use of chemicals and the dangers of the random use of chemicals on the health of farmers and consumers. Potential solutions for the minimal use of chemicals should be explored
- The study of Qat as an agricultural crop and the possibilities of the use of Qat products in the industry or medicine.
- The agricultural practices applied in Qat cultivation and potential improvement for sustainable use of resources.
- Potential crops for competition with Qat and the prerequisites for making this competition successful.
- The effect of chemical application in Qat cultivation on humans and the environment.

V. Proposals for Future Qat Research Projects

On the basis of the problems and knowledge gaps mentioned above, sound project proposals addressing these needs should be formulated.

In the following the attempt was made to summarize these needs in the form of project proposals that can be subject for discussion and further elaboration.

A. Socioeconomic Study on Qat in Different Production Systems

Justification

Available studies are lacking of quantitative information based on accurate surveys of the major production systems in which Qat is cultivated in order to create a clear picture on the role of Qat in these systems and its effect on the household economy in a direct or indirect manner.

Objectives

Create a clear picture on the role of Qat in the major production systems based on the analysis of quantitative data.

- Identify priorities of Qat problems faced by farmers and suggestions for solving these problems.
- Create a data base on socio-economic parameters in Qat cultivation such as: land ownership, land size, land tenure, irrigation methods, economic returns, technologies applied by farmers in Qat cultivation and the level of use of chemicals in these technologies.
- Create a data base on the environment in which Qat is being grown such as: soil types, soil depth, site topography, and climatic conditions in order to suggest potential crops to compete with Qat.

Expected outputs

- Quantitative data based on field surveys on Qat and its role in the household economy under different land tenure and land size.
- Priorities preferred from farmers' perspectives.

- Quantitative data on technologies applied by farmers in Qat cultivation in different agro-ecological zones and production systems, as well as information on Qat varieties, types, soil characteristics and topography.

Activities to be implemented

- Formation of a multidisciplinary team.
- Design and test a questionnaire for field surveys in selected and representative areas.
- Conduct field surveys following the questionnaire.
- Analyze data collected and formulate conclusions.
- Discuss findings with farming communities in areas where surveys were conducted.
- Prioritize problems and potential solutions.
- Formulate implementation plan to solve problems in a form of research and extension project proposals with budgets.
- Seek financial support to implement these proposals.

Budget: **15,000 USD**
Time frame: **Four Months**
Selected sites: **Hajja, Sana'a, Dhamar, Ta'iz, Dhaleh**

B. Water Management at the Field Level

Justification

Data on water management at the field level is not available in different production systems (irrigated, rainfed). Data is also not available on conditions of water sharing and on water rights and laws. There is a general belief that water applied in Qat cultivation is more than what the crop requires. However, data to support this statement is not available.

The socioeconomic study is expected to shed light on the practices of irrigation water application in Qat cultivation. This data will serve as a database for designing interventions in water management in different locations.

Objectives

- Design interventions based on information generated from selected areas representing the major production systems in Qat growing areas.
- Select modern irrigation techniques such as drip irrigation, sprinkler irrigation, bubbler irrigation.
- Test water levels in selected areas under the prevailing irrigation methods with the aim of reducing the amount of water application in the conventional methods.
- Define the critical periods for irrigation of Qat in different locations.
- Disseminate results generated in similar areas.

Expected output

- Modern methods of irrigation suitable for the types and varieties of Qat and new methods of cultivation introduced and applied.

- Crop water requirements under the different irrigation methods calculated and applied.
- Disseminate modern technologies in Qat irrigation to other Qat growing areas in Yemen.

Activities to be implemented

- Compile information on available technologies in Qat irrigation from results of socioeconomic studies and field surveys.
- Discuss these technologies with farmers in selected areas.
- Select farmers willing to participate on a partnership basis.
- Apply technologies appropriate to, or matching the type of technologies and water requirement.
- Organize field days to attract farmers' awareness and jointly assess the performance of different treatments under farmers' conditions.

Budget: **100,000 USD**

Time frame: **Two Years**

Selected Sites: **Hajja, Sana'a, Dhamar, Rada'a, Ta'iz, Dhaleh**

C. Alternatives to the Use of Chemicals in Qat Cultivation

Justification

The random use of chemicals in Qat cultivation became a problem. The negative effects of this random use of chemicals are feared to have drastic health and environment consequences on farmers and consumers as well. The chemicals are used to control insect pests. Some chemicals are also used as stimulants for stem elongation and improving the appearance of Qat leaves and stems.

Objectives

- Identification of chemicals used in Qat cultivation (types and quantities).
- Suggest alternatives based on field experiments with the aim of reducing the hazards of use of highly toxic chemicals.
- Compile the alternatives in a package of interventions with minimum use of chemicals.

Expected output

- Recommendations based on different scenarios as per the local conditions in which Qat is cultivated in the context of soil analysis and IPM approach issued and disseminated.
- Technologies on the application of chemicals with low toxicity applied in critical periods recommended and disseminated.

Activities to be carried out

- Selection of sites representing the major agro-ecological zones.

- Identification of chemicals used both in time of application and stage of crop growth.
- Aanlyze soil characteristics and quality of irrigation water in the selected areas.
- Conduct trials on farms on selected interventions with the aim of reducing the use of chemicals to the minimum.
- Suggest suitable interventions based on the findings of field trials and data available.

Budget: **50,000 USD**
Time frame: **Two Years**
Selected sites: **Dhamar, Rada'a, Sana'a**

D. Study of Potentials Crops for Possible Competition with Qat

Justification

Qat is grown under different production systems based on the source of irrigation as well as the level of soil fertility. Factors such as topography and the elevation above sea level play a role in Qat cultivation in terms of types and size of fields. Analysis of these factors in Qat growing areas will serve as a tool for possible suggestion of alternative crops that migh be potential competitors for Qat in economic returns and in sustainable use of resources.

Objectives

- Study the cultivation of Qat in different production systems.
- Study cultivation practices and economic returns of crops grown in the same environment.
- Suggest potential crops with high returns and comparative advantage which might be grown in pilot areas.

Expected output

- Detailed information on economic returns of crops grown in Qat growing areas collected.
- Detailed information on economic returns of Qat compiled.
- List of potential crops with high returns that can be grown in these environments completed.
- Pilot sites for cultivation of potential crops identified.
- Pilot sites established.

Activities to be carried out

- Select representative areas of Qat cultivation.
- Collect data on cultural methods and economics of crops grown in these areas.
- Collect data on agricultural practices and economics of Qat in the same areas.
- Select crops which might have comparative advantage in these areas.
- Establish pilot sites for cultivation of these potential crops.

Budget:	**200,000 USD**
Time frame:	**Five Years**
Selected Sites:	**Hajja, Sana'a, Dhamar, Rada'a, Ta'iz, Dhaleh**

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National Conference on Qat

CONFERENCE DISCUSSION MATERIALS

Fifeth Topic
Water Resources and Qat Production

Qat and Water Resources

By

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I. Introduction

The main reasons for the depletion of water resources in Yemen are population growth and the expansion of agriculture.

Agriculture on newly gained producing areas relies mostly on groundwater obtained from wells and on dam construction. This lead to a modernization of the agricultural sector since the 1980s, and consequently Yemeni farmers are able today to produce a variety of new non-traditional products, such as vegetables and fruits (Mangoes, Oranges, Potatoes). This development is in perfect harmony with government policy, which is encouraging and calling for rapid development and expansion of agriculture in Yemen. This policy, however, did fail to provide any measures and legislation for rationalizing and protecting water resources. The main target was to generate growth and secure market demand for vegetables and fruits. Consequently, this lead to an expansion of the agricultural area and to a rapid expansion of Qat production all over the country.

Despite this striking development in Qat agriculture, official statistics do not reflect this process. Today Qat makes up about 25 percent of Yemen's GDP, and up to 16 percent out of the total work force are employed in the Qat sector (production, transport, and marketing) *(World Bank 1996: Yemen towards a Water Strategy)*. Qat farming consumes 30 percent of total water used in agriculture.

The high profits generated by Qat production, encouraged farmers to drill deep wells and pump especially during the dry season water for irrigation purposes almost 24 hours a day.

In some areas where not enough ground water is available farmers transport water from far away places to irrigate their Qat farms. A cubic meter of water costs more than one dollar. Qat agriculture (97,672 hectares in 1998) consumes about 830 million cubic meters of water per year. It was among others the new irrigation techniques that allowed the rapid expansion of Qat farming area. In the time period between 1970 and1998 Qat area increased by over ten times from about 8,000 to 97,672 hectares. Today, Qat occupies about 8.2% of the total agricultural area in Yemen.

Studies indicate that the total renewable water resources of Yemen amount to 4.9 billion cubic meters. Considering the country's population which was said to be 17 million in 1998, this puts the individual's share to about 288 cu. meters per year. In the Middle East the average share of water for an individual is about 1250 m^3/year, and the world average is about 7500 m^3/year. The International norms are about 100 m^3/year for household use/person/year and a further 1000 m^3/year for food self sufficience. These statistics make it evident that Yemen is considered to be under the "water poverty line" (*World Bank 1996: Yemen towards a Water Strategy*).

The estimated use of water in Yemen was about 2.8 billion m^3/year in 1994, the annual renewal of water resources is however only 2.1 billion m^3. Yemen is thus overusing its water resources by 0.7 billion cu. meters per year.

The number of existing wells is estimated to be about 50,000, 200 drilling rigs are in use in the different areas of the country. With these drilling facilities wells are drilled without any permission or supervision by the authorities. The economic policy of low diesel price, providing of soft loans to the farmer, and making it easy to obtain irrigation systems has encouraged farmers to consume more water than can be recharged by rain. This lead in some areas to a depletion of water resources.

Concerned by this is also the Sana'a basin with its high population density and its intensive Qat, fruit and vegetable agriculture. Qat farming alone consumes in this area about 60 million m^3/year of water, while Sana'a's population consumes only about 30 million m^3/year. Many other cities are suffering from similar problems (*High Water Council, 1990*).

The old traditional society of Yemen was capable of controlling and guaranteeing the sustainability of natural resources, such as water and grazing areas. But the recent rapid economic developments have changed social life and the structure of society in Yemen, which has led to a loss of control over such resources.

As with regard to Qat, the absence of government policies has encouraged the expansion of Qat farms and the overuse of water. Today, however, the government is willing to take serious steps to protect water resources by increasing water unit prices and by canceling support that has in the past encouraged farmers to use water resources excessively.

Such a new approach of the government will need programs for public awareness, media attention, participation of governmental and non-governmental organizations, as well as the private sector in-order to raise more attention for water problems in Yemen. In addressing Yemen's water situation, and in particular the role of water in Qat agriculture, this paper is trying to contribute its share to this ambitious and urgent task.

II. Yemen's Water Resources

Yemen is situated in arid and semi-arid zone, which is known for its scarce rainfall and high evaporation. Pronounced differences in the topography affect climatic conditions and limit agriculture to areas of rainfall and groundwater availability such as the western mountains, basin areas, and *wadi* beds.

A. Surface Water

Surface water is considered to be an important source for irrigation in Yemen. Surface water consists of seasonal spate water and springs, with differing quality depending on the area. This source of water is less affected by drought and other natural and geographical factors. High runoff speed and heavy rainfall cause deep *wadis* and form several water basins. Orographic patterns control the flow off of rainwater and lead it in two directions, the outer water basins (draining to the west in the Red Sea and to the south in Gulf of Aden and Arabian Sea) and the internal water basins (draining east or west towards the Rub Al-Khali desert, the Ramlat sl-Sabatain and Wadi Hadramout).

Surface water in Yemen is estimated to be about 3500 Mm^3/year. Several dams and dikes were built on many main *wadis* for the purpose of directing spate waters into man made irrigation systems.

Table 1: Average Annual Rainfall and Surface Water Runoff in the Water Catchment of Yemen.

Water Catchment	Area Km^2	Annual Mean Rainfall mm	Annual Average Runoff Mm^3
1. Red Sea Basin	33,000	3,880	741
2. Gulf of Aden Basin	46,680		535
3. Rub Al-Khali Basin	90,900		171
4. Arabian Sea Basin	115,375		2000
A. Wadi running towards Ramlat Al-Sabatain Basin	45,000		315
B. Hadramut Masila Basin	46,075		116
C. Al-Ghaida Basin	24,000		77

Source: TNO Institute of Applied Geoscience, 1995.

B. Groundwater

Groundwater resources are vital for Yemen's agriculture. For their recharge they depend mainly on spate running water and rainfall. Runoffs and springs in catchment areas are the main sources of groundwater recharges. Groundwater resources are found in three important basins:

a.) Quartenary Tihama basins where the reserves of water are estimated to be about 250,000 Mm^3.

b.) Southern basins (west of Mukalla) (about 70,000Mm^3),

c.) Mukalla Complex (about 10,000,000 Mm^3). This includes Massila basin, Wadi Hadramaout and Shabwa basin of mountain areas where reserves are estimated to about 50,000 Mm^3.

Table 2: Present Draw of Water Recharge and Reserves in Main Basins

Water basin complex	Estimated draw Mm^3/year	Average Annual Recharge Mm^3	Fresh Water Reserves Mm^3
Tihama Basin Quaternary	810	550	250,000
South Coastal Basin, west of Mukalla	225	375	70,000
Mukalla Basin Formation in sandstone with interrelation with units of quartenary	575	500	10,000,000
High Area Basin most of it sedimentary.	500	100	50,000

Source: TNO Institute of Applied Geoscience (1995).

III. Current Water Use and Demand

A. Water Use in Agriculture

The agricultural area of Yemen was estimated in 1998 to be about 1,668,885 hectares of which 53% is irrigated by rainfall (678,243 hectares), while 47% (601,461 hectares) is irrigated by groundwater (30% = 383,192 ha.) or surface water from seasonal water floods (17% = 217,549 ha.). Of the latter 63,985 hectares are irrigated by springs.

The main rainfall areas are mountainous. Here terraces are built on which barley, sorghum, maize, some pulses, and of course Qat are grown. In some areas, particularly during dry seasons, supplementary irrigation is needed. Mostly surface and groundwater are used here.

B. Groundwater Use

Many farmers are pumping groundwater from wells by using diesel pumps or electric pumps. Such wells can have different production volumes from one basin to another. Their production is between 5 liter/sec to 50 liter/sec. There are 45,000 to 50,000 active wells have been estimated in Yemen. These wells have a relatively low production. The volume of the water that is pumped every year from these wells is about 2600 Mm^3. There are about 200 water well drilling rigs in use in Yemen that are owned by individuals or companies. They can be rented by financially well situated people (especially owners of Qat farms), who generally do not have any drilling permits, despite governmental legislation limiting the drilling of wells (Cabinet Resolution No. 438 for the year 1991 and the Minister of Agriculture Resolution No. 46 for the year 1992).

Another development improving the availability of water in farming areas is the rapidly spreading use of plastic and galvanized pipes. In the period between 1997 and 2000 about 20,000 hectares of farmland have been connected to wells by this means. It is expected that this figure will rise by 5000 ha a year until 2010 (*Ministry of Agriculture, Statistical Yearbook* 1998).

There are also estimates that there will be an improvement for using the available water at a 40% to 60% higher efficiency rate in irrigated areas, which will result in a reduction of water consumption (*Ministry of Agriculture, Statistical Yearbook* 1998).

Table 3:Use of Water for a Period of 20 Years (1990-2010) in Different Water Use Categories (Million cu. Meters/Year)

Water Use	1990	2010
Agriculture	2,700	3,328
Domestic	168	552
Industrial & Mining	31	90
Total	**2,899**	**3,970**

Source: TNO Institute of Applied Geoscience (1995).

IV. Future Water Balance

The water shortage that Yemen is currently facing (7,301 Mm^3 for the year 2000) will aggravate in coming years. Estimates on water usage for the year 2025 suggest a

water shortage of 17,368 Mm^3/year. This immense water shortage is one of the main challenge that Yemen will have to face in the 21st century. There are, however, several ways of coping with this challenge:

- Increase the efficiency of water resources available (optimal use of the water unit will result in higher social economic output and in saving water). An improved system of water use, advanced practical techniques, financial capability, social and official awareness, development of programs to achieve a balance between urban and rural areas, as well as an equal distribution of this resource is necessary to achieve this.
- Develop existing water resources, by the optimal use of rainfall and the improvement of water harvest, either for direct use or for increasing the recharge of groundwater, by searching for good traditional water sources, and by providing new techniques for water production from non-traditional water sources. To achieve all these aims considerable investment is however needed, as well as modern and advance techniques, energy, and last but not least, a strong government infrastructure.

V. Qat and Water

A. Qat Area

By looking at the agricultural statistics for the years 1970 to 2000 it becomes evident that the Qat growing area has increased rapidly over the past decades. In 1970 about 8,000 hectares were planted with Qat. By 2000 this had increased to 102,934 hectares, producing some 100.000 tons of Qat per year (see table 4). This represents about 9.5 % of the total cultivated land area. Water consumption of Qat is believed to be about 830 Mm^3/year. The number of Qat plantation owners is about 100,000, which represents about 1/3 of agricultural land ownership's in the country (*Ministry of Agriculture, Statistical Yearbooks* of 1998,1999and 2000)

Table 4: Development of Qat Growing Area in Yemen (1994-1998)

Year	1994	1995	1996	1997	1998	1999	2000
Area	86,825	88,939	91,418	93,246	97,672		102,934

Source: Agricultural Statistical Yearbook for 1998, Ministry of Agriculture & Irrigation, March, 1999

B. Climate and Soil Requirements

Qat grows in all agricultural areas of the western mountains above 800 meters, and is found to about 2600 meters above sea level. Qat is planted in different agricultural areas that have temperature between 16-25°C (*Agricultural Statistic Book, 1998* and *Ministry of Agriculture, March 1999*), such the *wadis* of the western low mountain areas, the terraces field of Jabal Saber in Taiz Governorate, or mountain wadis, such as Dhula'a and Bani Hushaish in the Sana'a Governorate.

Qat grows on different kinds of soil (light, medium, and strong soil). Qat also grow in different soil depths that range between 30 cm to one meter, or more. Qat grows in soil that is mixed with rocks and stones of good drainage (*Agricultural Statistic Book, 1998* and *Ministry of Agriculture, March 1999*).

C. Water Needs of Qat and Irrigation Practices

Qat benefits from available water resources, such as rainfall, floods, springs, and groundwater. Qat farmer sometimes bring water even from far away places by using trucks carrying water tanks. The high revenue generated by Qat farming also encourages farmers to drill deep wells despite high drilling costs. Farmers also install pump engines and build modern irrigation system using plastic and metal pipes. The length of these pipes often reaches several kilometers and carries water even to high mountain terrace fields.

Intensive irrigation and well drilling, however, strongly affects groundwater levels in Yemen. Over that past 20 years groundwater levels have decreased by up to 80 meters. One of the main reasons for this has to be seen in the expansion of Qat cultivation.

Young Qat plants are heavily depending on irrigation during nursing. After having been transplanted to the field in some cases rainfall is a sufficient water supply. Spring and summer are the best time for such a transplant since rainfall is available in these seasons. Water requirements can differ from region to region depending on the quality of soil, and climate. If rainfall is not sufficient during the first months, Qat plants need an organized irrigation system. In the first month after planting, the crops need to be irrigated every five days: In the second month the plants have to be irrigated every ten days, and in the third and fourth month irrigation once or twice a month is sufficient. Timing for irrigation is very important in the first stage of planting Qat, delays in water supply might let the leaves become dry and unsuitable for chewing. If plants, however, are watered too often, this decreases the stimulating effects of Qat.

D. Assessment of Water Requirements for Qat

There is no exact data on Qat water requirements, because the authorities have not given this issue enough attention in the past. Qat was not included in agricultural statistics.

Since 1996, however the government has shown more interest in Qat, and has been trying to establish a clear policy concerning Qat cultivation.

Qat has become a profitable business and consumed large quantities of water. Especially in areas where Qat was grown water resources became less and less. Farmers abandoned the growing of fruits and vegetables and start growing Qat instead. The area of Qat growing currently is about 97,672 hectares and consumes about 830 million cubic meter of water per year. In Sana'a governorate Qat consumes about 60 million cubic meter per year, while the population of Sana'a consumes about half of that.

The water requirement for Qat irrigation efficiency of 75% is about 8,500 m^3/year/hectare. Studies carried out by the High Water Council in 1992 show that the annual water requirement for Qat is about 12,000 m^3/year/hectare in Sana'a region.

In a study of agriculture and irrigation in the Taiz region, the water requirement for Qat was given with about 10,994 m^3/year/hectare *(Khaled Raiz* and *Ahmed al-Shami, 1998).*

A field survey carried out by the Qat Research Unit (headed by Dr. Ali Noman) in the Qat growing areas of the Sana'a, Hajja, Dhamar, Taiz, Dhala Governorates in 1998 found that water requirements of Qat ranges between 931 m^3 to 1966 m^3 (Hajja) and 1634 m^3 to 1638 m^3/year per hectare (Sana'a). These figures are estimates based on a questioning of farmers. Taking into account the evident different with the figues mentioned above, it seems recommendable to embark on a well-established program of research and field studies in order to obtain precise figures that could help to determine the actual water requirements of Qat irrigation, and thus maybe could help to save water. Until further reaserch will produce more precice figures, the authors use the figure of 8,500 m^3/hectare/year, which they view as a reasonable estimate. However, one should be aware of the fact that thisestimate does not take into account the different climates where Qat grows and where considerable differences in water requirements might be found.

E. Comparison between Water Quantities consumed by Qat and other Crops

Despite research in several agricultural areas of Yemen (using Benman formula, readjusted by the FAO to Yemeni circumstances) there are still many knowledge gaps concerning Qat agriculture.

Qat consumes large quantities of water (9010 m^3/h) in comparison with other agricultural products, such as corn (4577 m^3/h) or tomatoes (6048 m^3/h). It uses, however, significantly less than bananas (19,978 m^3/h) and coffee (13,360 m^3/h) (see table 5).

Table 5: Crop Water Requirements under Yemeni Climate Conditions (Using Benman Formula, Adjusted by FAO)

Crops	Est. Crop Water Requirement m^3/h	Efficiency Use of Water m^3	Total Irrigation Water Requirement	
			Surface Irr. 50%	Pressure Irr. 80%
Corn	4,577	0.2	9,154	5,721
Maize	5,040	0.7	10,080	6,300
Wheat	5,040	0.8	10,080	6,300
Cotton	7,056	0.12	14,112	8,820
Sesame	5,645	0.6	11,290	7,056
Tomatoes	6,048	3.65	12,096	7,560
Potatoes	5,040	2.03	10,080	6,300
Onion	5,544	3.4	1,188	6,930
Pulses	6,250	2.2	12,500	7,812.5
Banana	19,978	2.25	39,956	24,972
Qat	**9,010**	-	-	-
Coffee	13,360	-	-	-

Tobacco	8,080	..		-

Source: Agriculture and Water Journal, 1995 (Dr. Ahmed Saeed Al-Zari, Dr. Faisal Abdullah, *Jamal Al-Naqeeb*

Table 6: Estimates of Water Requirements for Irrigation of different Crops per Hectare

Crop	Total Average Quantity (thousand m^3/h)
Sorghum	13.5
Maize	14.1
Wheat	12.2
Coffee	20.3
Cotton	22.1
Qat	**17.5**
Alfa Alfa	43.7
Watermelon	15.7
Tomatoes	12.2
Beans	11.3
Grapes	30.4
Banana	33.9
Dates	12.6
Oranges	43.5

Source: High Water Council, 1992

F. Qat Irrigation Cost

The high demand for Qat resulted in an expansion of its cultivation at the expanse of other export cash crops such as coffee, fruits, and vegetables. In addition, this lead to an increase in the number of drilled wells and thus caused high extraction rates of groundwater. Qat cultivation is responsible for about 30% of the agricultural water consumption in Yemen. A continuation of this development must be seen as a threat to water resources, and might eventually lead to their depletion, especially so in the central and northern areas of the country.

The cost of Qat growing is about 30–50% of its sales price (*FAO* 1995). It is estimated that the total net revenue of one hectare ranges between YR 400,000 (US$ 3,100) and YR 600,000 (US$ 4,700) (*FAO* 1995). In another study by *Al-Hamdi* (1998) in Sana'a basin the total revenue from one hectare was estimated between 400,000 to 1,800,000 Rials. Water cost was calculated at 30–60 Rials/m^3 which will amount to 255,000–510,000 Rials (using the above estimate of 8,500 m^3/hectare/year) and labor between 2,300–2,500 Rials/day/hectare.

In some areas production costs are significantly higher, since farmer's are forced to transport water by trucks from far away wells or springs to the fields for irrigation.

Water costs can then be as high as 285 Rials/m^3. This is one of the reasons why the cost of Qat growing can differ from one governorate to another.

A study carried out by the FAO (*Economics of Qat production in the Republic of Yemen,* 1995) collected data on the cost of Qat production from farmers in Sana'a and Dhamar (as shown in table 7).

Table 7: Estimated Cost of Qat Production/Hectare irrigated by Groundwater (in Riyal).

Cost (Riyals)	1st Year	2 - 3 Years	4 - 8 Years
Total Revenue (actual)	0	48,000	320,000
Land Preparation	18,400	0	0
Qat cuttings	13,020	0	0
Cost of Irrigation	30,000	25,000	25,000
Chemical Fertilizer	0	0	10,850
Manure	3,200	0	2,500
Plant Protection & Pesticide	0	2,734	4,340
Labor	15,240	3,810	19,050
Net Revenue	**(-) 79,860**	**16,456**	**258,260**

Source: Economics of Qat Production in the Republic of Yemen, FAO, 1995

A study carried out by the Al-Afif Cultural Foundation in 1991 showed that Qat gives higher revenue than other products as follows:

Qat	250,000 Riyal/hectare/year
Grapes	90,000 Riyal/hectare/year
Banana	80,000 Riyal/hectare/year
Vegetables	50,000 Riyal/hectare/year

Table 8: Cost and Net Revenues in Rials/Hectare/Year of Productions in 20 Years Time From 1978-1998

Product	Cost in Rials/ha	Net Revenue in Rials/ha
Qat	41,715 – 60,366	48,618 – 63,360
Grapes	284,924	81,702
Oranges	29,233 – 68,823	27,735 – 36,340
Coffee	7,788 – 37,337	5,508 – 13,030
Bananas	53,325	3,334

Source: Arab Organization for Agriculture Development (June 1998): Technical, Economical and Social Aspects of Qat Growing in Yemen and its Related Projects.

G. Effects of Qat Growing on Water Resources

According to Ministry of Agriculture data (*Agricultural Statistical Yearbook*, 1995) the area cultivated with Qat expanded between 1970 and 1998 by 1221 percent (8,000 - 97,672 hectares). This expansion has negative effects on water resources particularly groundwater. As shown above, uncountable wells are drilled in all parts of the country and this development is often encouraged by low costs for pumps, diesel, and maintenance costs. Sometimes pumping facilities are even donated to the farmers by Government, a development which is not specific for Qat, but for agriculture in general.

In Sana'a basin the high extraction of groundwater may even lead to water depletion. The number of wells found in the Sana'a basin is about 7,000. The total agricultural area is about 107,000 hectares out of which 30,000 hectares are irrigated by groundwater (*National Water Resources Authority*, 1995). Qat area represents about 33% of the total agricultural area in Sana'a, and consumes 71 Mm^3 of the water used for agriculture, which was 176 Mm^3 in 1995 (see table 9).

Table 9: Water Requirements for different Purposes in Sana'a Basin (in Million Cubic Meters Per Year).

Year	Water Requirements			Total	Requirement of Qat Mm^3
	Agriculture	Domestic	Industry		
1990	151	22.8	4.7	178.5	59
1995	176	37	6.2	219.2	71
2000	207	62	8.2	277.3	-
2010	288	138	15	441	128

Source: National Water Resources Authority (NWRA), Statistical Book, 1999

A report by the National Water Resources Authority (NWRA, 1995) on the water situation in the Sana'a basin stated that the quantity of water consumed in 1990 by agriculture, households and the industry amounted to 178 Mm^3. An increase in consumption was observed in the following years. For 1995 NWRA reports a consumption of 219 Mm^3. The share of Qat has risen between 1990 and 1995 from 59 to 71 Mm^3.

NWRA believes that water consumption in the Sana'a basin will more that double by the year 2010 (441 Mm^3). The water use for Qat is expected to reach 128 Mm^3 in 2010 which is 29 percent of total water consumption in this region.. If no measures are taken to rationalize water consumption in the Sana'a basin there will be a danger of water depletion. This could lead a drying out of the basin and may cause desertification and thus a diminution or even extinction of agriculture in this area. If this trend is not stopped by reducing Qat cultivation in the Sana'a basin or by finding irrigation methods using less water, this will lead to a direct competition between households and Qat farmers for water resources in the near future.

H. Difficulties faced by Qat Farmers in obtaining Water

Qat farmers are facing a number of difficulties in areas of water shortage. This is especially true in areas where Qat has to be irrigated by groundwater (wells, springs) or by water transport from remote areas.

The main difficulties in obtaining water are:

- Surface water shortages due to reduced rainfall.
- Falling groundwater levels that can result in the falling dry of wells.
- Increasing water costs.
- High cost of well drilling, especially deep wells.
- Erosion of agricultural lands by floods.
- Limited agricultural services in some areas (lack of irrigation pipes and technical advice by professionals, etc.)
- Social problems that can render some agricultural areas useless (e.g. land and water disputes that result in security problems).

I. How Qat Farmers would solve Water Shortage Problems

Qat farmers were questioned on how they think water problems in Yemen could be solved. Their ideas and propositions are summarized here:

- Necessity of building small dams and dikes by the government for the purpose of groundwater recharge and for drinking water.
- Government assistance in erosion protection of agriculture terraces.
- Government intervention in resolving disputes about agriculture lands in some regions.
- Government assistance in providing agricultural services such as extension services by professionals and engineers from the Ministry of Agriculture and Irrigation.
- Need of new irrigation techniques.

VII. Recommendations

The water problem in Yemen is an issue that affects all people. The shortage of water is constantly growing and the rapid expansion of Qat farming is aggravating the situation even further. In order to satisfy the water needs of households, industry, and agriculture and in order to guarantee water sustainability for the future there is urgent need for government action. Serious measures must be taken and wide public awareness must be risen.

To start this process the following is recommended:

- Introduce new techniques and management for saving water for agriculture.
- Make available new irrigation techniques (nominal priced) to farmers who shift from Qat growing to other products.
- Diversify the rural economy by establishing small industries, (quarries, mining, etc).

- Stop providing irrigation facilities, support or donations of equipment to Qat farmers.
- Install water meters on wellheads, especially in areas growing Qat.
- Rise unit price for water.
- Stop drilling and deepening of water wells in depleting basins.
- Provide investments for water harvest projects and for the use of supplementary irrigation techniques, such as building small dams and dikes
- Eliminate soil erosion by reconstructing terraces, planting trees, better techniques for water harvest (the 1996 floods lead to large scale soil erosion, in the same time the recharges of groundwater significantly reduced).
- Protect and maintain agricultural terraces and support rainfed agriculture.
- Conduct further research on how to develop suitable techniques for water resources management
- Rationalize water use in all sectors and improve the networks of water distribution to decrease leakage.
- Develop public awareness through high political leadership, government and parliament, sheiks, traditional corporations, branches of official corporations and boards in the governorates, governors, NGOs, the private sector, public media, water users and all stakeholders.

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National Conference on Qat

CONFERENCE DISCUSSION MATERIALS

Sixth Topic

The Qat Factor in Yemen's Economy

Qat and Yemen's Economy

By

Faissal Said Fare and Peer Gatter

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I. Introduction

Writing on the economics of qat is beset with a number of difficulties. The most striking of these is the lack of data on the crop due to a government policy that all too long neglected this important issue. Two agricultural surveys have been carried out in the past decades. Their results seem however little reliable since the surveys were based on samples, limited in number and area. What is more, the surveys failed to differentiate between qat qualities and varieties (price differences), as well as between tree heights (production volumes).

Problematic for obtaining accurate data on the crop is also that qat prices are never stable, neither seasonally nor geographically. In spite of the spread of the qat habit throughout the country prices depend on the abundance of rainfall, temperatures, and on the distance of the production areas from the markets.

Consequently, until today no reliable data bases exists on vital issues such as production volumes and costs, extent of planting area, methods of production, qat taxes, as well as value added of qat.

Therefore even official government statistics on qat are estimates. Actual figures may be much higher than currently available data suggests. The reader should therefore bear in mind, that the data discussed in this study needs to be treated cautiously (compare also the article on "*Statistical Data on Qat*" in this book).

This is all the worse, considering the effects of qat on Yemeni society and the country's economy. Qat cultivation affects food security, prices, foreign trade, economic performance, production efficiency (loss of working hours), and last but not least, the health of its consumers since the profitability of qat cultivation leads farmers to use fertilizers and pesticides to accelerate its maturity and increase yields.

At the same time the exceptional profit generated by qat cultivation has created an army of laborers involved in qat production and marketing. The crop also created novel incomes that affect the economic structure in general - a development which not necessarily is all negative.

This study is trying to address the unbalanced relationship between the qat economy and long-term development in Yemen. Since qat penetrates virtually every aspect of Yemeni life, a study on the role of Qat in the country's economy will necessarily also have to include agriculture, the alimentary situation, and the country's job market. In addition the effects of qat on social position, work performance, as well as its consequences for family spending and government revenue are discussed.

II. Qat and the Gross Domestic Product

Yemen is considered to be one of the countries where most qat is produced and consumed. The area cultivated with Qat has expanded from 8,000 hectares in 1970 to about 100,000 hectares in 1999. Today the plant accounts for a vast and ever rising share of the total agricultural production, a development which began in the 1970s. Migrant worker revenue sent back to Yemen from abroad lead to deep

changes in agriculture and triggered a shift from the cultivation of fruits, vegetables, and cash crops to the predominant planting of Qat (see table 5).

It was however only in 1996 that Qat figures have been included in national statistics and thus in GDP calculations. Despite this, when defining the share of Qat in agriculture and Yemen's GDP, one is all to often confronted with differing official figures.

Qat production is estimated to amount to 14,786 million Rials in 1990 (current rate), i.e. 12.6 percent of GDP, whereas it was about 25,077 million Rials in 1995 (current rate), i.e. about 7.6 percent of GDP (see table 1). Other calculations suggest 12.0 and 5.6 percent respectively (see table 2).

When comparing the different sectors of the economy during the 1990s (using current rates), Qat's GDP share tends steadily to be decreasing in comparison to other sectors. This is however not due to diminishing Qat production but mainly due to the increasing output of the oil sector (14 percent of GDP in 1990 and 30.3 percent in 1996). Consequently agriculture's GDP share decreased from 28 to 16.5 percent over the same period (see table 1). Considering the visibly increasing volumes of qat sold in the markets and the ever increasing consumption levels in Yemen, it seems also possible that government data is simply incorrect.

But even government data does not fail to illustrate the importance of qat in Yemen's economy. It needs to be stressed that in the years 1991-1994 the output of qat even exceeded the GDP share of petroleum (see table 1).

Table 1: Structure of Yemen's GDP for 1990-1998 (in Percent per Sector, at current rates).

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Agriculture (total)	27.94	24.51	25.85	25.23	25.97	21.57	16.54	15.15	16.66
Qat Agriculture	*12.59*	*11.86*	*10.5*	*10.23*	*10.39*	*7.58*	*5.68*	*5.56*	*6.65*
Oil Sector	14.04	10.57	7.7	6.41	7.49	16.58	30.31	29.55	18.91
Transformational Industries	8.11	9.76	11.1	9.81	9.24	10.21	10.69	11.06	12.19
Electricity, water, gas	3.43	3.02	2.71	2.62	2.23	2.03	1.69	1.67	1.77
Construction	2.68	3.16	3.59	3.9	3.72	3.82	3.58	4.35	4.97
Commerce (wholesale, retail), restaurants, hotels	12.64	14.16	14.17	15.23	16.15	14.68	11.11	10.88	12.35
Transportation and stock	6.86	7.3	7.66	8.9	8.74	7.45	6.41	7.15	9.19
Finance and assurance	5.6	7.41	6.76	6.98	8.07	6.92	5.61	5.13	6.49
Services	1.67	1.66	1.8	1.99	1.69	1.98	1.88	2.33	2.61
Gov. service products	15.84	17.24	17.77	18.57	18.08	14.69	11.29	11.43	14.29

Source: CSO 1998, Ministry of Planning April 1999, and *Central Bank of Yemen* 1998.

42.5 percent of the overall agricultural output (representing 14,786 million Rials) were generated by Qat production in 1990. For 1995 the share of Qat in agricultural production was somewhat lower with 26.2 percent or 25,077 million Rials (at 1990 rates) but still represents over a quarter of agricultural production

(see table 2). The crop accounted in 1998 for 48.7 percent of the agriculturally used trees and for 57.9 percent of the area cultivated with cash crops (compared to 15.3 and 18.2 percent for coffee respectively). In 1995 Qat was responsible for 24.8 percent of value added of the agricultural sector (*Ministry of Planning* 1996, First five-year plan for economical and social development 1996-2000).

Table 2: Share of Qat Agriculture in GDP for 1990-1999 (at current rates in million Yemeni Rials).

Year	GDP	GDP of the Agri-cultural Sector	Plant Production	Qat Agriculture in the GDP *	Percentage Share of Qat *	
					of GDP	of Agric.
1990	123,343	34,816	30,420	14,786	12.0 %	42.5 %
1991	146,012	36,057	31,311	15,927	10.9 %	50.9 %
1992	182,786	47,507	39,743	17,300	9.5 %	36.4 %
1993	220,249	52,785	43,735	18,949	8.6 %	35.9 %
1994	268,789	70,996	52,227	22,134	8.2 %	31.2 %
1995	447,753	95,778	68,740	25,077	5.6 %	26.2 %

Source: Calculations based on CSO brochures 1990-1995 and the CSO Statistical Yearbook 1997 (Ministry of Planning, Sana'a, Yemen). * Note that the share of Qat in GDP does not exactly correspond with the figures in table 1. This is due to the inaccuracy of government data.

Despite the relative decrease of Qat's GDP share over the past decade (see tables 1 & 2). Qat plays a prominent role in Yemen's economy and has a strong impact also on related sectors. These include transportation, marketing, and commercial margins (wholesale and retail). Qat related economic activities therefore positively affect national revenue, and Qat directly contributes to the growth of the Yemeni economy, well beyond the agricultural sector.

III. The Profitability of the Qat Sector and its Importance for generating Employment

In 1990 the annual output of one hectare of Qat was YR 185,760 before deduction of taxes and intermediaries' profits, and YR 145,635 after the deduction of taxes and intermediaries' profits. In 1995 figures were YR 413,316 and 320,733 respectively 1995 (at current prices) (*al-Mohajed* 1998).

The above figures show that the annual farmers net income from Qat has increased between 1990 and 1995 by 120.2 percent (at current prices). Tax deductions and intermediary profits have roughly remained the same for 1990 and 1995, with 21.6 percent and 22.4 percent for the respective years (*al-Mohajed* 1998).

The profitability of one hectare of Qat is a manifold of that of other crops. In 1997 a hectare of Qat generated a gross income of 515,000 Rials compared to only YR 26,000 for a one hectare of wheat (i.e. only 5 percent of the profitability of Qat). The profitability of Qat is double that of fruits, three times that of vegetables,

and more than six times that of forage. Therefore it is quite simple to understand why many farmers abandon cereal production in order to plant Qat. This however leads to a sharp decline in Yemen's food production.

Today the Qat sector (production, transport, and marketing) provides work opportunities for many Yemenis. In 1995 the Qat sector offered employment for 16 percent of the total workforce and for 28 percent of agricultural sector employees (ca. 500,000 people) (*World Bank* and *CSO*, various years).

IV. Qat and Government Revenue

The qat sector contributes to government revenue in two ways: by a qat consumption tax (levied on qat transport and marketing) and a religious *Zakat* duty (levied on qat production). While *Zakat* is collected at the farm level by *Zakat* assessors, the consumption tax is collected at checkpoints located at the bottlenecks of the roads leading to the main consumption centers, as well as in the qat markets of each city. The portion of government revenue derived from the qat sector is however nearly negligible(for more detailed information on qat taxation see also article *Statistical Data on Qat* in this book).

Zakat on Qat

Zakat is collected based on the Zakat assessor's and the farm owner's estimates of the annual output of a qat field. Based on the religious law, the *Zakat* duty is set to 10 percent of profit in rainfed farming areas. Since artificial irrigation has its cost, *Zakat* on irrigated farming is set to 5 percent. The first applies to about three quarters of the cultivated area (rainfed), the latter to another quarter (irrigated by wells) as the 1989 agricultural survey revealed.

Qat Consumption Tax

Law has set qat tax to 10 percent of the value of qat (Law No.14 of 1980) and later to 20 percent (Law No. 70 of 1991). According to government calculations qat consumption tax should make up about 10 percent of state revenue.

Taxes actually levied fall short of that (see table 3). It is well known that due to tax evasion, especially in the case of qat, the state loses annually millions of Rials. It seems likely that 70-90 percent of qat consumption tax that should be levied is not being collected. In the year 1998 this would represent a loss of 4,239 to 16,351 million Rials.

Table 3: The Role of Qat in Tax Revenue in the Years 1990, 1994 and 1998.

	1990	1994	1998
	in 1000 Rials	*1000 Rials*	*1000 Rials*
Total Tax Revenue	13,733,075	25,358,569	79,949,512
Qat Consumption Tax	298,417	664,864	1,816,732
Qat Zakat	193,091	181,359	325,965

Source: Taxation Department, Ministry of Finance, Sana'a, Yemen

In 1990 total revenue income was 13,733 million Yemeni Rials (YR). *Zakat* made up only YR 193 million (1.4 % of total revenue) and qat consumption tax YR 298 million (2.2 %) in the same year (see table 3).

In 1994 state tax revenue was with YR 25,358 million about the double of 1990. This is also true for qat consumption tax that amounted to YR 665 million in 1994 (2.6 %). However, *Zakat* lagged behind with YR 181 million (0.7 %).

Four years later, in 1998, government revenue amounted to YR 79,950 million. Qat consumption tax was YR 1,817 million (2.3 %) and Zakat only YR 326 million (0.4 %)

From the above it becomes apparent that while the share of qat consumption tax in total government revenue was rather stable over the years with about 2.4 percent, the share of qat *zakat* was steadily diminishing from 1.4 percent in 1990 to 0.4 percent in 1998.

When analyzing *Zakat* statistics of the past decade and comparing them with qat production area and its rapid increase over the past years, it becomes obvious that only a minor fraction of the total *Zakat* due on qat production can actually have been collected. Yemeni qat production attained YR 14.8 billion in 1990 and went up to YR 25.1 billion in 1995 (current prices).

The loss for the state treasury due to *Zakat* evasion is likely to amount to about 80-90 percent of what should actually be levied. This represents losses of about 1,304 to 2,934 million Rials in 1998.

Reasons for this might be the weak performance of tax organs, unclear laws, the methods by which Qat taxes are levied at checkpoints or at Qat markets, as well as widespread corruption among tax collectors (for more details also see the article *Statistical Data on Qat*, for the taxation system see *Ward & Gatter* 2000).

V. Qat and Food Security in Yemen

The agricultural sector plays a key role in a country's economy, because it guarantees the alimentation of its population. Misbalance between population growth, growth of the agricultural area and agricultural output can result in a loss of self-sufficiency and can make foreign food imports necessary. Often this results in balance of payment problems and rising foreign debt of which many third world countries are suffering.

In Yemen the imbalance of these factors led to the alimentation problems the country Yemen is facing today. While the population increased by four times since the mid twentieth century (4.3 million in 1950, 18 millions in 2000) agricultural production and expansion of arable land area lack far behind. With an annual population growth rate of 3.5 - 3.7 percent (one of the highest in the world) Yemen is facing a population of around 27.5 million by 2010. Population growth led to a considerable decrease of the individual's share of cultivable land: In 1975 1 hectare of agricultural land was shared among 4.76 persons, in 1997 this had risen to 15 (*Mojahed* 1998). The urbanism (with the spread of construction on arable land) has contributed to this to some degree, as has the erosion of cultivated land (decrease of 30 percent between 1975-1997) (*Mojahed* 1998).

Rapid population growth also soon had to lead to food imports. The first shipload of wheat (some 14,000 tons) arrived as a gift of the USA in Yemen as early as 1959. This was soon to be followed by regular wheat shipments that were either gifts or were bought at a low price (*al-Awlaqi* 1998). Yet, until the late 1960s Yemen was self-sufficient to an extent of 86.4 percent (see table 4). The country even exported cash crops like coffee and farmers cultivated cereals in such quantities that they were able to sell or exchange their produce for things in need. But by 1995/96, the country's self-sufficiency rate had fallen to 34 percent.

Table 4: General Self-Sufficiency of Cereals

	1969/70	1975/76	1977/78	1995/96
Local production (thousand ton)	794	1058	700	810
Imports (thousand ton)	125	210	290	1505
Total	919	1268	990	2315
Proportion of self-sufficiency	**86.4%**	**83.4%**	**70.7%**	**34%**

Source: Al-Awlaqi 1998 (For the 1980s unfortunately no data could be found).

One of the main factors that lead to the decline in food security must be seen in rising Qat production. No other crop was as profitable as Qat. Cereal production decreased from 1,275,000 tons in 1975 to 720,000 tons in 1997, while Qat production increased over the same period from about 31,390 tons to 88,772 tons.

The share of growing area of each crop also made a shift towards Qat production. While the land share of cereal decreased between 1970 and 1996 from 85 to 61 percent of the overall agricultural area, Qat area rose from 3 percent to 7.6 percent in the same period of time (see table 5).

The area of Qat attained 90 percent of the area of wheat cultivation, three times that of coffee, and also passed that of vegetables and fruits in 1997 (see table 5). Nevertheless the, also the cultivation of other cash crops, fruits and vegetables experienced an upwards trend. Production area of vegetables has increased in from 2 percent in 1970 (183,000 tons) to 5 percent in 1996 (more than 747,000 tons). A similar development is observed in fruits. Here production area increased from 2 percent in 1970 (128,000 tons) to 7 percent in 1996 (554,000 tons) (see table 5).

Table 5: Use of Agricultural Land in 1970 and 1996 (in Percent)

Product	**1970**	**1996**
Cereals	85 %	61 %
Qat	*3*	*7.6*
Cash Crops (Cotton, Coffee, etc.)	5	11.4
Fodder	3 %	8 %
Fruits	2 %	7 %
Vegetables	2 %	5 %

TOTAL	100 %	100 %

Source: Al-Awlaqi 1998 and CSO 1999.

Despite these partial production increases as well as slight increases of the agricultural area, food imports *(including drinks)* make up the major share of Yemen's imports today (around 30 percent in 1996/97) (*al-Afoury* 1999).

By 1990, imports of wheat and flour exceeded 800,000 tons per year, and were in the year of 1995 even supported by the government with 400 million US-Dollars. Even when government support was off, imports of wheat and flour still increased and reached 2,000,000 tons by the end of 1996. For the year 2000 the figure is expected to rise to about 2,300,000 tons (*al-Alwlaqi* 1998).

Also isolated government efforts to curb food imports (1984 was *declared Year of Agriculture* and imports of fruit and vegetables were temporarily abandoned in order to encourage local production) have had little impact until now and the trend to more outside dependence is likely to continue due to a number of factors, such as:

- population growth,
- decrease of arable land due to urbanism and erosion
- rising water shortage problems,
- the ongoing expansion of Qat cultivation at the expense of food crops, due to high profitability and ever rising demand
- immigration from rural areas to the urban centers and thus a relative decrease in numbers of farmers,
- decreasing investment in the agricultural sector, or its misuse.

VI. Qat and Income

A. Effects on the Family Budget

The 1992 and 1998 Household Budget Surveys revealed that family expenditure on Qat is substantial. After cereals and animal products it takes third place on the expenditure ladder (excluding non-food items, luxury goods, and services). In 1992 Qat expenditure accounted for 8.3 percent of family spending (YR 1,090/month). In 1998 8.6 percent of the family budget were consecrated to Qat (YR 2,797/month) (see table 6).

Table 6: Household Budget Surveys of 1992 and 1998 (Relative Expenditure in Percent in Urban and Rural, as well as the Republic as a whole).

	1992 Survey			1998 Survey		
	Urban	Rural	Republic	Urban	Rural	Republic
Cereals & their Products	10.3	17.1	15.5	8.5	17.2	14.8
Legumes	1.9	1.8	1.8	1.4	1.3	1.3
Vegetables	5.9	4.6	4.9	6	4.6	5
Fruits	2.5	2.3	2.4	2.6	2.9	2.8
Meats, Poultry, Fish, Eggs	14.6	11.7	12.4	10.4	10.3	10.3
Milk and Dairy Products	3.4	3.3	3.3	3.6	5.5	5
Edible Fats and Oils	3.5	4.4	4.2	2.5	5.1	4.4
Sugar & its Products	4.4	5.6	5.3	2.8	5	4.4
Condiments & Spices	1.6	1.3	1.4	3.4	2	2.4
Tea, Coffee, Cocoa	1.8	2.8	2.6	1.1	2.1	1.8
Mineral Water & Soda Drinks	1.1	1	1	1.1	0.8	0.9
Tobacco	3.3	3.2	3.2	2	2.2	2.1
Qat	***9.5***	***7.9***	***8.3***	***8.7***	***8.5***	***8.6***
Other Non-Food Items & Luxuries & Services	36.2	33	33.7	45.9	32.5	36.2
TOTAL	100	100	100	100	100	100

Source: Central Statistical Organization, Household Budget Survey 1996 and 1999.

It is therefore evident that Qat has a direct impact on family life. This also explains the fact why most Yemenis do not possess any savings, which is especially true for those with limited income (majority of people). Qat thus negatively affects not only the social and economic situation but also of the entire economy of the country. Qat must also be held responsible for rising prices of alimentary products. This obviously affects the cost of living as well as production costs, particularly in the handicraft sectors. Diminishing purchasing power is the result. High prices are also responsible for the susceptibility of many to bribery, in order to enable them to buy qat. Quantitative data on this is however not available.

A recent survey by *Lenaers & Gatter* suggests that the 1992 and 1998 Household Budget Surveys greatly understate the importance of qat in family expenditures. In this survey, results show an average spending as much as 28 percent of the family bufget on qat. Regional and rural-urban differences were found, but figures never dropped below 23 percent. In some areas, such as the coastal plain of the Tihama, the share spent on qat was even as high as 33 percent of financial resources available to a family each month. The share was lower in qat producing areas such as Mahwiet since market prices are lower there and many families that plant some qat on their land for home consumption even if they are not qat farmers (*Lenaers & Gatter* 1999).

A limited survey carried out by the authors among Sana'a University employees in early 2000 (sample size = 79) came to similar conclusions. It shows that today qat expenditure is much higher than established by the household budget surveys. The average salary of a Sana'a government employee (at Sana'a University) amounts to around YR 10,000 per month. The average expenditure on qat amounts to YR 300 per day and the average number of chewing days/week was found to be 4. An employee thus spends YR 4,800 per month on qat; i.e. 48 percent of his regular monthly income. It however has to be noted that many Yemenis (46 percent of the sample) have another job after official working hours and have thus

an additional income. For those 46 percent the share of qat in family spending is consequently lower. Since many respondents however declined to reveal their after working hour earnings, it was not possible to determine the actual extent of qat spending in the income of these individuals.

B. Qat and its Effects Income Distribution

Besides its effects on family expenditure qat also has a significant impact on savings and income distribution. The groups of people that are able to save money in Yemen, are agricultural landowners and businessmen (many of whom sell qat). Since qat is essentially a domestic consumer product, qat money circulation is mostly an internal phenomenon and takes place between consumers, retailers, transporters, and qat producers. This results in a tremendous accumulation of money on the side of those involved in qat production and retail.

Profits generated by the Qat sector are also responsible for tremendous financial transfers from the cities to the countryside. At first sight this could be considered a positive development. It however needs to be emphasized that the ownership of Qat farms is concentrated in the hands of a few, since land ownership in Yemen is based on inequality (see table 7). Consequently Qat money is controlled by a very small part of society and is not used to the best of the country, as to finance projects of rural development or the building up of a powerful industrial and handicrafts sector. Qat money is rather invested in the construction sector which promises high returns in a short period of time, or is used to finance smuggling of leisure products and commodities like refrigerators, cars and generators. It is also used to buy gold and foreign currency (phenomenon of dollarization) and is used to finance well drilling to guarantee a further expansion of Qat agriculture, since this promises high returns.

Table 7: Land Ownership in Yemen in 1993 (Number of Land Owners and Size of their Land Holdings in Hectare)

Agricultural land possession (in Ha.)	No. of land owners	Area per ownership category (in Ha.)	Average land possession (in Ha.)
Less than 0.5 Ha.	455,851 (52.1%)	90,740 (5.8%)	0.2
0.5 – 2	258,947 (29.6%)	250,914 (16.0 %)	1.0.
2 – 4	81,990 (9.4%)	208,988 (13.3%)	2.5
4 - 20 and more	77,483 (8.9%)	1,019,211 (64.9%)	13.2
Total	874,271 (100%)	1,569,853 (100%)	1.8

Source: Calculations by the author on the based on the Agricultural Land Possession Survey of 1993.

Table 7 shows a considerable difference in the ownership average of agricultural land in Yemen. While the majority of land owners (52.1 percent) possesses only 5.8 percent of the agricultural land (average of 0.2 ha. per person), a minority (8.9 percent) possesses 64.9 percent of fertile land (average of 13.2 ha. per person).

Land cultivated with Qat is estimated to occupy about one third of total land possessions in Yemen. Considering the above figures, this confirms that there is only a limited number of people who is able to generate high revenues and to save money.

VII. Qat and Social Position

The considerable profits generated by the Qat economy help producers and merchants to maintain their high social position. By creating jobs in rural areas, the Qat sector is supporting the tribes. Business relations between producers, intermediaries and retailers forge bonds between various economic, tribal, and political classes that are involved in the Qat economy. Once within this "qat-system", one is unable to put pressure on Qat producers or merchants.

The political, economic, and tribal elite is split into two camps: The ones that profit directly from Qat and the others that profit indirectly from it. The first are unlikely to take a stand against Qat, because it is the Qat sector that generates their wealth. The second may also be reluctant to join the campaign against Qat, since their status is based on good personal and business relations with the Qat sector. Thus they rather prefer to keep good relations with the Qat sector, than to fight it.

VIII. The Impact of Qat on Work Efficiency and Economic Performance

Some researchers consider Qat to be the main reason for wasting precious working hours, that are supposed to be devoted to production. Often calculations due to time loss have been presented in order to describe Qat as an obstacle to development (e.g. *al-Zubeidy*):

> "Supposing that those who chew Qat in Yemen amount to around 2,924,500 million people (both male and female) and supposing 4-6 hours to be the average of daily chewing time (= wasted hours), then this would result in about 11,698,000 to 17,547,000 wasted working hours per day."

This hypothesis is however only correct if no work is carried out during Qat chewing, and if Qat is chewed during working hours. But chewing habits vary from one person to another. Construction workers, farmers, taxi drivers, and craftsmen work actively while chewing Qat. For them it is a stimulant providing energy, in other words, they believe that they cannot work without chewing. Employees of private enterprises or the government often chew Qat after working hours, so no working time is lost due to active chewing. In addition to this it should be noted that in many offices chewing is not accepted. In government institutions it is even illegal since 1998.

The actual figure for lost working hours is thus considerably lower. Nevertheless Qat consumption provokes insomnia and a loss of appetite. Right after chewing Qat many users feel incapable to perform work. Result can be that people who have chewed Qat the previous day, perform poorly dung official working hours. It is however hardly possible to assess the amount of hours lost due to this.

IX. Recommendations on how to Address the Qat Phenomenon

The Qat phenomenon has a broad dimension which is difficult to face in the short run. Addressing it therefore requires a long-term strategy, providing gradual solutions rather than brusque official decisions. Alternatives must be created for Qat chewers, as well as for those who economically benefit from the Qat sector.

Some examples for long term measures dealing with the Qat problem are given in the following:

A. Support Further Research in order to Update Data on Qat and fill Research Gaps

When approaching the Qat phenomenon we are often confronted with research gaps and outdated data. Research centers that study the economic, social, and health impacts of Qat should therefore be encouraged in their work and be financially supported.

In a number of fields the lack of information is already apparent now. Further studies should determine the:

- real size of area of qat cultivation (including the area of each variety of qat),
- geographical distribution of qat cultivation (concentrations),
- size and ownership of qat-land holdings,
- irrigation methods,
- water, fertilizer and pesticide requirements according to each qat-type and compare these to those of alternative products,
- suitability of land for cultivating other products,
- productive margins, marketing and transport margins, as well as marketing methods compared to those of other crops,
- method used in collecting taxes,
- contribution of qat to the GNP and GDP, as well as its effects on related sectors, investment, savings, inflation, unemployment, balance of payments, and overall development,
- actual sources of income that go towards the purchase of qat,
- reasons why people consume Qat (differentiate by their social, educational, and economic status).

B. Create Alternative Leisure Opportunities

The roots of Qat consumption go back hundreds of years, which makes it a well established social and cultural custom. The high level of qat consumption in Yemen is often attributed to the lack of alternative leisure opportunities. Following this logic, it seems likely that consumption may be reduced by creating alternative opportunities for leisure. To create leisure facilities that will be accepted by the public, an assessment is necessary of why different individuals or groups chew qat.

Therefore different chewer categories should be identified and leisure opportunities created according to their needs (some are given here):

- Many Yemenis chew qat because they have nothing else to do in their free time. To address this chewer type the government could provide facilities such as public parks and clubs, or public libraries with their attractive facilities such as internet access, video films, seminars, cultural and scientific tours and courses.
- For the group using qat due to the lack of work at the workplace, the government and the public sector should revise their working hours and adapt them to an efficient exploitation of the energies of their employees (such as splitting the working hours into two periods - a morning and an afternoon period - with an increase of pay to make it attractive for the employees to return to work during the afternoons).
- For those using qat because they are unemployed, public projects should be set up that generate jobs. In addition the private sector should be encouraged or pressured to create jobs and employ such people after an adequate study of their capabilities and skills.
- For the group that uses qat because of social customs (weddings), religious, and political occasions, the appropriate alternative would lie in providing (free of charge or at a low charge) attractively equipped public areas for such occassions (in clubs, hotels, mosque facilities, on the premises of political parties and community organizations). In these places the use of qat would however be banned.

C. Raising of Public Awareness

The media (television, radio, and press) should participate in the public mobilization against Qat in order to create an awareness of the harmful social, economic, and in particular health effects of Qat. An effective campaign would have to include the Qat issue in TV shows, and theater plays.

Other institutions that should include the Qat issue in their activities include the Ministry of Education, that should include the Qat issue in the school and university curricula, the Ministry of Health (including health centers and hospitals), the Ministry of Guidance with its affiliated mosques and prayer leaders, and the Ministry of Information & Culture.

Also research centers, associations, clubs, hospitals, mosques, women-institutions, charity organizations, agricultural cooperatives, political parties and community organizations should become involved.

D. Prohibition of Chewing in Public Places

When addressing the Qat phenomenon the method of persuasion should be followed rather than that of compulsion, taking into consideration that all that is forbidden becomes more desirable. The prohibition of Qat consumption in general is not likely to meet much success. But chewing should be prohibited at the workplace and in public areas (such as parks, clubs, movie houses, busses, airports,

seaports, schools and hospital etc.). Fines should be imposed on those who chew qat at the workplace or in public areas. Their Qat should be confiscated and destroyed.

E. Possibilities for Crop Substitution

The profitability of Qat asks for lucrative alternatives for its producers, marketers and transporters. Alternative agricultural products generating high returns could help to convince growers to substitute qat.

This could be achieved by raising the returns of alternative crops, which would require an increase in their prices and a reduction of their growing cost. Raising the returns of alternative crops could require the opening of foreign markets. This would require the setting up of marketing companies for alternative products. These need to be run by able individuals in the view of strong competition on international markets and of competing foreign products on the domestic market, especially if Yemen opts for the liberalized trade approach.

It would also require to improve of the quality of domestic agricultural products so that they will meet international standards, and thus will be able to compete with similar foreign products. This would require optimal use of nursery plants or seeds, as well as fertilizers, pesticides and irrigation. This in turn requires the existence of centers for agricultural research in many of the areas where qat is grown.

These centers will need to carry out tests and experiments that are appropriate for the climatic conditions of Yemen (soil, quantity of water), so that alternative crops can be produced at lower costs and improved in quality which would guarantee higher returns. This would make the provision of support and facilities for farmers who work towards replacing qat with such products necessary. Such a strategy would need the participation and support of the Ministry of Agriculture, cooperative societies, political parties and community organizations.

Export will also work towards reducing the supply of these alternative products in the domestic market. This would consequently lead to price increases and to higher returns for farmers. Eventually these alternative crops would be able to compete with qat in terms of profitability.

To set an example the government should not just encourage qat farmers to turn towards alternative crops, but should also replace qat in its own government farms and on land holdings of the religious endowments. To make the private sector turn away from qat, financial government support should be made available for qat substitution efforts. Privileges can be given to farmers cultivating any crops other than Qat. Support could include the placing of seedlings and agricultural machines at the disposal of farmers at a low price or even free of charge. Agricultural credits should be limited to farmers planting other crops than Qat. Markets for alternative crops should be created not only abroad, but also locally.

The government should also encourage the private sector to reclaim non-farmed land, especially in large unused land areas in Wadi Hadhramaut, al-Mahara, Mareb, Shabwa, Abyan, al-Jawf, and the Tihama (areas that are too low or too hot for Qat production, but where water sources are available), and plant alternative

crops on these so that the share of food products in Yemen's agricultural output rises. The government should support them by the construction of rain water dams, in the maintenance of terraces, and in the construction of an infrastructure that will contribute to the reclamation process.

F. Confronting Qat as an Economic Phenomenon

Addressing qat as an economic phenomenon needs substantial financial resources. It is therefore elmentary for the government to make Qat taxation efficient and use these resources towards the creation of a fund for economic and social development. The resources of such an entity could be used to support qat substitution and to generate other sources of income for the qat transport and marketing sectors.

Measures could include:

- Imposing on farmers and landowners to cultivate crops other than qat. Per farm, qat area should not exceed the area of food crops planted. This would still allow farmers to plant some qat, but it would also force them to produce food crops of strategic importance.
- Imposing standards for Qat merchandising: merchants would need to have sales permits, appropriate places for Qat selling would have to be assigned to them, inspections of the merchandise would need to be carried out (pesticide use, variety, etc.), distributors would have to wash and clean qat leaves prior to selling them, control organs would need to monitor the implementation of the above, severe punishments for violations, especially for the violation of health regulations would need to be imposed.
- An new system of taxation should be designed to ensure efficience of tax collection. Part of this revenue income should be used to promote agricultural development projects in which fruit, vegetables and cotton are grown.
- Why not import Qat from Ethiopia? International competition could lead to a lowering of Qat prices in Yemen, since Ethiopian Qat is known to be much cheaper than Yemen grown Qat. This could take pressure of the family budget. Ethiopian Qat is also said to not be treated with pesticides, which would have positive effects on the health of consumers.

G. Protect Water Resources

The high water use of Qat is a waste limiting groundwater resources. To prevent a water crisis in Yemen stricter laws for water use and well drilling should be designed. The methods of irrigation need to be improved. Dams and cement canals need to be built, and techniques like drip irrigation or babbler systems should be promoted. Also water use in the industrial sector and in private households should be revised and made more efficient.

H. Assure International Support

Contacts with regional and international organizations (like FAO, UNESCO, WHO) should be established in order to obtain funds for the studies and programs described above.

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National Conference on Qat

CONFERENCE DISCUSSION MATERIALS

Seventh Topic
Qat and its Role in Yemen's Rural Economy

Qat and its Role in Yemen's Rural Economy

An Exemplary Study of Qat Growing and Marketing in the Governbrates Of Hajja, Sana'a and Taiz

By
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List of Tables

I. Introduction

Despite Qat having become a subject of interest in Yemen as well as abroad, very little is known about the production of this crop.

In 2000 a book on Qat, written by respected researchers and notable university lecturers, has been published under the title "*Qat, an Integrated Approach, Issues and Effects*" (*Hadrani* (ed.) 2000). This piece of work sums up the latest state of research on different qat related issues. In its articles is shows very clearly the knowledge gaps that still dominate our perception of qat. This is especially true for the agricultural and economic sides of crop as the reader can infer from the open questions in this book (*Gatter* in *Hadrani* 2000, p. 254-256), such as:

- What is the actual area of Qat cultivation?
- What is the production capacity of a Qat unit area, and Qat production generally?
- What are the costs of production? What are the net returns attained by the farmer from a unit area?
- What is the share of each member of the farming family out of the net Qat returns?
- How much does irrigation cost? And what is the quantity of water consumption in a unit area?
- What kind of workforce is used to produce Qat?
- What methods are used in Qat agriculture in the different producing regions?
- What is the relationship of Qat growing with child and women labor?

These open questions were taken into account during our field survey. The focus of the study is directed to the methods of qat farming, the water consumption of Qat, the returns of Qat farming, the Qat labor force and its share in the total of agricultural work force.

II. Methodology

A. The Questionnaire and its Field Testing

In a first stage, a four page preliminary questionnaire was designed, trying to cover aspects seen as vital in order to gain understanding of the role of qat in the rural economy.

A field testing of the questionnaire was carried out in Sana'a governorate's Bait al-Shami village (Maswar area, Khawlan district). The team was accompanied by a guide chosen for his knowledge of the area and his popularity among the people of this region. This helped the team to gain the recognition and trust of the Qat farmers and guaranteed to some extent the readiness of farmers to participate in the survey and to reply truthfully to questions relating to Qat production and household issues.

Having carried out the field testing it became clear that the questionnaire needed to be divided into separate sections: one for Qat producers, one for Qat merchants or mediators, and a third one on development aspects related to Qat farming (public services such as paving roads, establishing schools, and health centers).

B. Selection of Research Areas

In a second stage the research areas were selected. The survey focused on three Qat growing governorates. These were Hajja, Sana'a, and Taiz. These administrative regions were selected because of their diversity as well as climatic and topographic considerations. On the first account, they belong to the southern, central and northern Qat growing regions of the country and are substantially different in population structure, history and traditional leadership. Therefore, they represent a significant sample.

1. Hajja Governorate

In **al-Mahabesha district** the villages of ar-Rasa'a, Suq al-Makhaidherah, al-Kamah, Bab al-Mohr, and ad-Dahna were visited. In **Najara district** the survey included Dawas village. These two administrative regions were chosen due to the cultivation of two very different Qat types: The first is the *al-Shami* type, which al-Mahabesha is famous for, and which is considered one of the best kinds of Qat in Yemen. The second one is called **Najri**, found in Najara area, and is considered to be of less quality.

2. Sana'a Governorate

In the governate of Sana'a the district of **Khawlan** was chosen with the villages of Bait al-Khardal and al-Muena'a. While the village of al-Muena'a was chosen for its dependency on irrigation via springs streams, floods and surface wells as well as its average quality qat, Bait al-Khardal was chosen due to its good quality Qat and its dependency on underground wells for Qat irrigation.

3. Taiz Governorate

In the governate of Taiz the districts of **al-Maqarima** and **al-Maqatira** were chosen. The first area was selected because its medium quality Qat and its dependency on shallow wells (hand-dug wells, less than 10 meters in depth).

Al-Maqatira district with Mesayjid village was chosen because it is dependant on irrigation by rain, springs, wells and water basins. Even though al-Maqatira was made in 1996 a part of Lahej governorate, it can geographically be considered part of Taiz governorate. This area is famous for its Qat, which is considered one of the finest in the southern Qat growing region. Qat from this area is marketed especially in the southern governorates.

C. Collection of Data

In the third stage, data on Qat growing was collected in the field. Experience gained during previous field surveys on Qat proved valuable to the members of the Qat Research Unit team (the objective of these earlier studies was data gathering for the establishment of an information bank that would enable government to draw up development plans and agricultural policies).

The survey team visited eleven Qat growing areas in three governorates during the period of June to August 2000.

Altogether 79 farmers were interviewed (Hajja 21, Sana'a 33, and Taiz 25). Participants were randomly chosen among the Qat farming population. The sample included small, medium and big Qat farmers.

Due to their fear of higher taxes, it proved at times quite difficult to interview Qat farmers on topics such as production costs, profits and taxes. Some of the interviewed are likely to have exaggerated in their statements on actual tax payments and production cost and downplayed real profits. Another problem proved to be the inability of some farmers to give exact information on amounts of fertilizer, pesticides and water use per unit area.

The method of questioning of farmers had thus to be adapted to this reality: The first contact with the farmers was thus made with a guide known in the region - this created some trust. The guide, together with the research team leader, explained to the farmers in a simple words the survey's objectives. Upon this each members of the team sat with one farmer of the respective village and filled out the questionnaire with him. After completion, a meeting would be held with all interviewed farmers, in which results were jointly discussed, and in some cases false data corrected.

Another way of obtaining correct information was by rephrasing questions, asking in indirect ways, or by asking more than one person at one farm. Questions, especially such that were unsatisfactorily answered before, were also repeated in the more informal discussion rounds that were mostly accompanied by a meal and followed by Qat chewing.

A factor that should be taken into account, is also that the time of survey coincided with a period of extreme draught, which forced farmers to irrigate more than in normal years. This could have had an impact on figures of water use. Also water was in this time period more expensive than usual, therefore also irrigation costs reflected in this article may be somewhat above the usual average.

D. Evaluation of Data

After concluding the field surveys, the gathered data was evaluated, in a fourth stage. This proved in part to be a difficult task, since all the locally differing unit measurements (e.g. for land size) used by farmers, had to be converted into comparable parameters (e.g. *habal* and *libna* into hectares). This was quite important to allow comparisons between irrigation, fertilizer use, labor cost, and returns per land unit. In this stage also several verification visits were carried out in the Sana'a area, to check the reliability of results.

III. Results

A. Hajja Governorate

The governorate of Hajja has an area of 10,195 km² and a population of approximately 1.4 million (CSO 1999).

Cereal crops such as sorghum, millet, oats, barely, maize, as well as, legumes various vegetables and fruits are cultivated in Hajja. However, Qat occupies today a large portion of the agricultural area, estimated to amount to 14,740 hectares (CSO agricultural statistics 1999) or to 25.8 percent of the total agricultural area of the governorate (57,113 ha.).

Rough estimates of the survey team based on a counting of Qat land holdings and their size however suggest that rather 36.850 ha, or about 64.5 percent of the total agricultural area in this governorate are planted to Qat.

The Hajja survey included the Najara district with Dawas village and the Jabal Najara and the al-Mahabesha district with al-Rasa'a and with Jabal Sham. In both regions Qat growing has replaced other crops on the high plateau and the terrace fields. Its cultivation is widespread and dense. Here even the rehabilitation of old and eroded agricultural terraces and the building of new ones for qat planting was observed - the only crop justifying such enormous expenses. In both districts Qat growing was still found at altitudes as low as 600 m above sea level.

Unit Measurements

Traditional measurement units used to determine the size of land holdings were found to differ in the two research areas. In the Dawas region the *Libna* is used which equals here about 70.6 m² (8.4×8.4 m). One hectare is thus equivalent to 141.7 *Libnas*. (1 In the Rasa'a region the *Habal* (lit. string) represents the traditional measurement. A *Habal* equals in Hajja governorate to about 207.4 m² (14.4 m x 14.4 m). A hectare thus equals about 48.2 *Habal* (it needs however to be noted that *Libna* and *Habal* can differ considerably in size depending on region within Yemen).

1. Dawas Region (Najara District)

a.) Geography and Climate

Dawas village is located 27 km northwest of the governorate capital Hajja at about 1500 m above sea level. It is situated on a rocky mountain top (Jabal Najara), amidst terrace fields (average of 3 meters in dept, decreasing in size towards the pinnacle). In the west of this region the topography is abruptly descending towards the coastal plain of the Tihama. Qat is planted predominatly on terraces fields here.

Mild winters and warm summers characterize the climate of this area. Average annual rainfall is between 400-600 mm. The period of rains is mostly summer and autumn.

b.) Social Characteristics

Random samples taken in this region (n=8) showed that the average family size is 7 persons, of which 3 are male, 4 female. Land generally is privately owned and an average farming family owns approx. 0.8 hectares of arable land.

c.) Crop Composition

Qat occupies a vast area of the terrace terrain starting from about 600 m (mostly however 750 m) to an altitude of 1,800 m above sea level. Qat cultivation accounts in this area for about 36.3 percent (or 0.29 ha.) of the total land possessions of farmers which are on average 0.8 hectare in Hajara district. Another 44 percent are cultivated with cereals and the remaining 18.7 percent are made up of un-arable land. Vegetables (0.5 %) and fruits (0.5 %) are found only on a very negligible area in the immediate vicinity of the farmers' houses and are planted for personal consumption, rather than for sale. Corn and sorghum are planted in rows among Qat trees. In about one third of the Qat terrace fields scattered sorghum and millet plantings were found. However, agricultural land on the slopes of Wadi Khafiya is planted with grains, with rainfall being the main source of irrigation.

d.) Characteristics of Qat Farming and Production Inputs

Growing Pattern

Two growing patterns were observed in this region. Following the old pattern, Qat trees are randomly planted; they can reach heights of over 6 meters and can be over 60 years old. Approximately every 16 trees make up a *Libna* (70.6 m^2), i.e. each tree has an area of 4.41 m^2, which is equivalent to approximately 2,268 trees per hectare.

Following the new pattern, Qat trees are planted in rows. The distance from one planting hole to the next is 0.5 to 0.6 meters. The rows are 1.2 to 2 meters apart. The Qat trees reach about 1.5 to 3 meters in height; the maximum age is around 20 years. Around some older trees younger ones are grown. When planting new fields with Qat, between 8-15 shoots (average 12) are planted per hole. There are approximately 74 holes per *Libna* (about 888 shoots/*Libna*) or holes 10,486 per hectare (about 125,830 shoots/ha.). Only one plant (rarely 2) per hole survives and becomes a tree. Economic production of these new plants begins after 3-4 years. On such new plantations on average 85 trees are found per *Libna* or 12,045 trees per hectare.

The old fields are deeply ploughed 1 to 2 times a year, whereas the new ones 2-3 times.

For Qat fields (old and new) an average of about 36 trees per *Libna* was found in the Dawas region (5,101 per ha.)

Irrigation

Qat cultivation in the Dawas region depends mainly on rainfall, since there are no wells found here. In the dry season (May-June) and during the drier winter months (December/January), however, farmers irrigate qat trees using rain water collected in traditional basins during the previous rainy season (hand dug basins or cisterns with storage capacity range from 100-200 m^3).

During especially dry periods additional water has to be bought for YR 1000/m^3 and is transported by trucks with tanks carrying 10-18 m^3.

To produce qat of high quality, water application needs to be done carefully and is considered a real art. Plants are not irrigated by flodding the fields as observed in some regions, but are watered with 20-litre plastic cans. To keep the water at the tree, little

basins are shoveled around the tree. Each tree is given 20-60 liters per irrigation. If we suppose an average of 40 liters per tree, then 640 liters are needed to irrigate one Libna of old Qat plants (16 x 40 l.) and 3,400 liters to irrigate one Libna of young Qat plants (85 x 40 l.) (see above).

With an average of 3 harvest a year and 3 water applications before each harvest, this would amount per Libna to 5,760 liters for old Qat fields and 26,640 liters for new ones.

Fertilizer and Pesticide Use

Organic fertilizers such as dung are used in Qat cultivation once a year (2-3 sacks, 30 kg each, per *Libna*). Urea is used in differing quantities from between 100-150 grams per plant and year, applied some weeks before each of the year's 3 pickings. Quantities differ according to soil quality.

Chemical and fungi pesticides are used on average 4-5 times per year and are applied some time before picking. Qat is usually harvested 3-6 days after last pesticide application. Products used have names such as "Topaz", "Superacid" and "Perfectioun".

e.) From the Field to the Market

Harvesting

In the Dawas region, farmers harvest their Qat on average three times a year. A minority picks Qat leaves even up to 5 times annually.

The first picking is carried out during the rainy season (end of March/April). A second one takes place during the dry season (June/July), and a third picking is done during the autumn rains (end of August/September). A fourth harvest may take place in the winter months (December/January), when both, prices and quality of Qat are high, and a fifth picking of Qat leaves may be done for special occasions and religious holidays.

To prepare trees for picking, farmers do not irrigate for a period of 30-45 days. After this they spray pesticides and water the trees 2-3 times in a very short period of time and finally pick the leaves 3-6 days after the last watering.

The productivity of trees grown according to the new agricultural pattern is much higher than of those grown with the old pattern. Trees are more densely planted and allow more harvests.

Production Volume

The branches harvested are 35-45 cm in length. They are usually bound into bundles called *Rubta*. The weight of such a Qat bundle is about 350-400 grams. Per Tree production is between (3-5) bundles (average 4). With an average of 36 trees per *Libna* thus 144 Rubta are harvested annualy. With 5,101 trees per hectare this amounts to 20,405 bundles.

The price the farmer achieves for a bundle is on average YR 222. Qat produced per hectare and year would thus sell for YR 4,529,910. Numbers are higher for

irrigated agriculture (up to YR 14.69 Mln.) and lower for rain dependent fields (YR 433,000/ha./year).

Transportation and Marketing

There are two ways of harvesting: Qat is either directly marketed after picking by the farmer himself or the whole harvest is sold before picking to merchants and brokers. The latter then come to harvest the leaves with their own workers. Around 35% of farmers market their Qat directly and 75% sell it to merchants and mediators.

Each *Rubta* is sold for an average of YR 222 at the farm level (price depending on quality and climatic conditions like temperatures and the abundance of rain).

f.) Costs and Profits

Cost of Qat Production

The cost of Qat production was found to amount to YR 801,582 (ca. USD 5,010) per hectare and year. This includes labor cost, as well as costs for water, fertilizers and pesticides.

The total cost of irrigation in the Dawas region is about YR 120,730 per hectare and year (i.e. 15.1 percent of the overall production cost) (see table 1). Of this YR 46,530 are paid for water and a further YR 74,200 for irrigation labor (5.8 and 9.3 percent of total cost respectively). In years when surface water is sufficient, than farmers have no cost irrigation other than for irrigation labor, since springs and water reservoirs are owned by the farmers. In the below calculation (table 1) irrigation labor also includes labor cost for fertilizer application, which is carried out by the same laborers.

The high cost of irrigation in the Dawas area can be explained due to the long draughts that this region has experienced during past years. Farmers were thus often forced to buy water that had to be transported over great distances (ca. YR 1000/m^3). Under normal climatic conditions irrigation cost per hectare and year was said to amount to just YR 61,335 in the Dawas Region.

Fertilizers (organic and chemical) cost the farmer YR 28,767 per year and hectare, or 3.6 percent of the overall production cost. Labor costs for weeding, Ploughing and trimming account for another 28.1 percent (YR 225,100).

Despite of pesticide application being little labor intensive, labor cost is relatively high. This can be attricuted to the fact that there is already a certain sensitization to the dangers of pesticides to health. Many workers carry out this task for not more than 3 hours per day (to limit exposure to these products), but charge the entire day. Cost for the pesticides and for there application is relatively equal and amounts to about YR 91,000 each, or to 11.35 percent (22.7 for both) of total production cost.

Costs for picking and guarding amount to YR 169,200 and YR 75,785 respectively per hectare and year or to 21.1 and 9.4 percent of the total production cost (production cost for the farmer is lower, if the intermediary brings his own laborers to harvest the Qat).

Production cost is thus mostly made up of labor cost (79.3 percent) and amounts to YR 635,285 per hectare and year, and only to a quite small share of costs for water

(5.8 percent), pesticides (11.35 percent) and fertilizers (3.6 percent), amounting together to YR 166,297.

The labor costs making up such a large share in Qat productions illustrates well, why about 81 percent of laborers' income in the Dawas area are from Qat cultivation.

Table 1: **Annual Production Cost of one Hectare of Qat in the Dawas Region**

Item	Qat production cost/ha. and year	Percentage of total process	Labor cost in Rials/ha. and year	Percentage of total process
Irrigation	120,730	15.1 %	74,200	9.3 %
Weeding/plough./trimm.	225,100	28.1 %	225,100	28.1
Organic fertilizers	21,150	2.6 %	-	-
Chemical fertilizers	7,617	1 %	-	-
Pesticides	182,000	22.7 %	91,000	11.35 %
Picking	169,200	21.1 %	169,200	21.1 %
Guarding	75,785	9.4 %	75,785	9.4 %
Total	**801,582**	**100%**	**635,285**	**79.3 %**

Profits

Profits of farmers depend on whether they sell their harvest to an intermediary/merchant or whether they sell it themselves at a Qat market. Since it proved too difficult to verify the second possibility, that would include further cost calculations (e.g. gasoline, car maintenance, sales tax, etc.) only profits were calculated for farmers that are selling their harvest at the farm to a merchant or intermediary. Here the average output per hectare and year was YR 4,529,910 (see above).

After the deduction of production cost (YR 801,582) and Zakat (5 percent of net profit = 186,416 YR) the farmer is left with a **net profit of YR 3,541,912**.

This means that the ratio of production cost (YR 801,582) to profits (YR 3.5 million) is 1:4.4 - for Bananas it is just 1:1.

2. Ar-Rasa'a Region (al-Mahabesha District)

a.) Topography and Climate

The mountainous ar-Rasa'a region is situated at the north-western edge of Hajja governorate and about 140 km from Hajja city. The mountain ridges, overlooking the coastal plain of the Tihama, are characterized by steep slopes that are covered with beautiful agricultural terraces having a deep and fertile soil. Qat is planted in considerable quantities on mountain terraces, in all higher wadis up to 2000 meters in altitude, and is even grows in lowland areas of around 600 meters. The climate in this northern highland region is characterized by cold winters and mild summers, with rainfall during summer and autumn (500-600 mm per annum). When descending further towards the Tihama plain, the summers become more humid and the winters milder.

b.) Social Characteristics

Data levied from a sample of 13 randomly chosen farmers of ar-Rasa'a revealed that the average family size is 14 persons, of which 7 are male, 7 female. Private property is the dominant system of land ownership and the average size of land holdings of a family is 0.6 hectare or 29 *Habal* (1 *Habal* = 207.4 m²).

c.) Crop Composition

Qat cultivation occupies about 95 percent of the total cultivable area. Of the agricultural land cultivated by a farming family (average 0.61 ha or 29 *Habal*) thus about 0.58 ha. are planted with Qat

Sorghum (1.5 % of area) and fodder (1 %) are found only on rare occasions, planted among the Qat trees, and are used to feed animals. For subsistence purposes some fruit trees (1.5 %) are maintained and vegetables are planted (1 %) close to the farmers dwellings.

d.) Characteristics of Qat Farming and Production Inputs

Growing Pattern

In the old pattern, there are 2-3 meter trees with 5-7 high. The average age of Qat trees in such plantations is about 60 years. At times some younger trees are planted in among the old ones.

There were hardly any new plantations with young trees found. However, following this modern pattern observed now and then, Qat trees are in rows that are two meters from each other. Within each row there are 2 meters space between each planting hole (3-5 shoots/hole). After the second year, between each planting hole a new shoot is planted, reducing distance within the rows to one meter. The height of young trees reaches on average 1.5 meters, but some may reach 3 meters in height. Annually the qat trees are trimmed, and every 8 years they are pruned to ground level.

On average (old/new) 80 trees are grown per *Habal* and 3,856 per hectare.

Land is usually ploughed once a year, some farmers however stated to plough only every second year.

Irrigation

During the summer and autumn months Qat plants usually receive sufficient rainfall. During the dry winter months however additional water is needed, which is transported to the fields by truck, mostly from the shallow wells in Wadi Massrouh which runs at the foot of al-Sham mountain.

In the past two years this area has experienced very low rainfall, so that even during summer and autumn it became more and more necessary to used additional irrigation.

Each truck load of water is on average 10 m³. This is sufficient for once irrigating 0.5 Habal. To irrigate one hectare of Qat consequently 97 truckloads or 970 m³ of water are needed. Per harvest two irrigations are necessary during the months with

little or no rainfall. This means that 1940 m^3 or 194 truckloads are needed per harvest and hectare.

A truck-load of water (10 m^3) is sold for 900-1000 YR in this area. High prices have led farmers to use water carefully and avoid its overuse. The low water quantities given to the plants produce a good quality, but expensive qat with a lot of taste and giving high keif (Exiting/enjoyment) - overuse of water generally produces a qat of low quality with little taste and low in keif.

Fertilizer and Pesticide Use

In Qat agriculture organic as well as chemical fertilizers are used. The use of urea (chemical fertilizer) is quite frequent, less common is the use of compound chemicals such as Sineral. Micro-element fertilizers are also used by spraying to the leaves.

Another method of enriching the fields is by adding fertile soil taken from other areas once a year.

In order to protect the Qat plants from pests, various types of chemical pesticides such as Drobihun, Mtathun, Super, Depretix, Fistax and, Parvtoti (French made) are applied.

Also organic pesticides are used in Qat cultivation, among them are Pavestine and Topaz that are applied in order to increase Qat growth and thus output. Random use of pesticides and various kinds of chemical fertilizers without adequate safety measures was frequently found. Sometimes even children (12-15 years old) carry out the spraying. Many farmers also do not respect a safety period and spay pesticides until the harvesting of leaves. Chewers are thus directly exposed to these chemicals.

e.) From the Field to the Market

Harvesting

Qat is picked 4-5 times annually in ar-Rasa'a. The number of harvests is dependent on rainfall and the ability of farmers to afford water transported by truck to the fields. Two pickings (April and September) depend basically on rainfall. Three further pickings depend on additional irrigation (June, December and February.

Production Volume

Production increases during the dry and hot summer months and decreases during the colder months of winter and autumn (but during the latter two producing a better quality).

Qat is picked at varying lengths of between 20-50 cm. The branches are tied in small bundles (500 g) that in turn are tied into larger bundles that weigh 15-20 kg. Per harvest (depending on season) one tree produces about 9 small bundles. With 80 trees per *Habal* (207.4 m^2) this amounts to 720 bundles a year and 34,704 hèr hectare.

The price the farmer achieves for a bundle is on average YR 567. The annual output of one hectare would thus sell for YR 19,677,168.

Transportation and Marketing

After picking, farmers sell some of their Qat in local markets of al-Mahabesha district. Farmers transport their Qat to the market by rented cars. The vehicle owners charge the farmers 10 percent of the sales value of the Qat they transport.

Most Qat is however bought directly by merchants and middlemen at the farm and is from there transported at high speed to the big cities (Hajja, Hudeidah, Sana'a) or the Saudi Arabian border. The transportation cars are hired by the merchants and middlemen. They are usually four-wheel drive and quite new so that transport on the mountain roads is quite fast. Thus these cars do not last long and are soon sold off and replaced by new ones.

f.) Costs and Profits of Qat Production

Production cost for one hectare of Qat was found to average YR 1,114,934 in ar-Rasa'a region. With YR 576.000, irrigation costs accounted for 51.7 percent of the total production costs. The bulk of this was water cost with YR 504,000, labor cost being only YR 72,000 (comprising also cost for fertilizer application) (see table 2).

Fertilizers (organic and chemical) cost the farmer YR 54,564 per year and hectare, or 4.9 percent of the overall production cost. Labor costs for weeding, Ploughing and trimming accounts for another 14.1 percent (YR 156,800). Pesticide cost and cost for spraying account for 16.5 percent of production cost and each amount to about YR 92,160.

Costs for picking and guarding amount to YR 115,250 and YR 28,000 respectively per hectare and year or to 10.3 and 2.5 percent of the total production cost (production cost for the farmer is lower, if the intermediary brings his own laborers to harvest the Qat).

In sharp contrast to the Dawas region, in Rasa'a not labor (41.6 %) accounts for the major share of production cost, but water (51.7 %). The total cost of labor amounts to YR 464,210 per year and hectare.

Table 2: Annual Production Cost of one Hectare of Qat in the Rasa'a Region

Item	Qat production cost/ha. and year	Percentage of total process	Labor cost in Rials/ha. and year	Percentage of total process
Irrigation	576.000	51.7 %	72.000	6.4 %
Weeding/Plough./Trimm.	156.800	14.1 %	156.800	14.1 %
Organic fertilizers	12.000	1.1 %	-	-
Chemical fertilizers	42.564	3.8 %	-	-
Pesticides	184.320	16.5 %	92.160	8.3 %
Picking	115.250	10.3 %	115.250	10.3 %
Guarding	28.000	2.5 %	28.000	2.5 %
Total	**1,114,934**	**100%**	**464,210**	**41.6 %**

Income from Qat farming nearly accounts for 100 percent of farmers' income since other agricultural earnings are insignificant. Per hectare and year plantation output is YR 19,677,168.

After the deduction of production cost (YR 1,114,934) and Zakat (5 percent of net profit = 928,112 YR) the farmer is left with a **net profit of YR 17,634,122.**

This means that the ratio of production cost (YR 1,114,934) to profits (YR 17.6 mio.) is 1 : 15.8.

B. Sana'a Governorate[i]

Before the newly created Amran governorate was carved out of parts of Sana'a and other adjacent governorates in 1999 the total area of Sana'a governorate was 38,605 km² (CSO 1996). Total population was estimated to amount to about 1.2 million in 1999 (without the governorate of the capital Sana'a which has a population of another 1.4 million (CSO 1999)). Since the governorate of Sana'a has become smaller due to the recent reform of governorates, the above figures (besides that for the capital) are likely to be lower now. Updated numbers reflecting the new reality are not available yet.

Two areas were surveyed in Sana'a governorate. These were Bait al-Khardal and al-Muena'a village, both in the Khawlan district. Due to great similarities these two regions were treated in one chapter in the following.

Unit Measurements

The traditional land measurment unit found in Sana'a governorate is the "*Libna* of tens" (*Libna Usharia*) since each *Libna* equals to 10 x 10 *Hadawi* yards (1 yard = 0.7 meter) or 7 x 7 meters. One Sana'a *Libna* thus equals to 49 m² and one hectare to 204.1 *Libnas*.

1. Bait al-Khardal and al-Muena'a Regions (Khawlan District)

a.) Topography and Climate

The two surveyed regions lie 40 kilometers to the east of Sana'a at an altitude of about 2,200-2,300 m above sea level. These regions are characterized by hilly volcanic rock formations that are cut by low altitude valleys and flood paths. Agricultural land is found mainly on the terraced slopes of the hills and mountains, as well as in the beds and on the edges of the valleys. Agricultural plots of a farmer are usually rather small and scattered over this rocky area.

In this region summers are mild and winters cold and dry. Rainfall is on average 250 mm per annum, the rainy seasons being in spring (March/April) and early autumn (August/September), when evaporation is usually high.

b.) Social Characteristics

Data levied from a sample of 6 randomly chosen farmers of the Bait al-Khardal region revealed that the average family size is 11 persons, of which 5 are male, 6 female. Land generally is privately owned and an average farming family owns approximately 1.95 hectares of arable land.

In al-Muena'a region (sample of 7 farmers) average family size is 12 persons, 6 male and 6 female. Also in al-Muena'a land is usually privately owned and average farm size is about 1.42 hectares.

c.) Crop Composition

In both regions of study, cereals are planted, especially millet, which the region is rather famous for, since it is excellent in quality and quite expensive. Different famous kinds of grapes, such as white and *Rezegy*, known also as *al-Masswari*, are grown.

According to the interviewed, Qat cultivation started spreading in both regions only about 50 years ago. Before this time, Qat cultures were very seldom. Nowadays however almost all grape yards have been cleared for Qat growing.

In Bait al-Khardal Qat occupies today about 8 percent or 0.15 hectare of the farming area of a family. The average age of the Qat fields was found to be 25 years. On a further 40 percent of farmland cereals are cultivated, on 15 percent vegetables, on 30 percent fruit, the remaining 7 percent are cultivated with fodder crops.

In al-Muena'a area Qat cultivation accounted for about 30 percent (0.42 ha) of family farmland. Here Qat trees are on average 35 years of age. On a further 45 percent of farmland cereals are planted, on 13 percent vegetables and on the remaining 12 percent fruit. Fodder was planted in very negligible quantities of below one percent of total farming area.

d.) Characteristics of Qat Farming and Production Inputs

Growing Pattern

Growing patterns in Bait al-Khardal and al-Muena'a regions were found to be the same. In the older fields (age ca. 20-35 years) Qat trees are randomly planted in a distance of 2 to 3 meters from each other, with the average number of trees per *Libna* being 8 (1,633 trees/ha.). Tree height is approximately 4-6 meters.

In newly created fields Qat trees are planted in lines that are 1-1.5 m from each other. Distance of Qat plants within each line is about 0.4-0.6 m. An average of 81 trees per *Libna* is found (16,532 tree per hectare) with a high of 1-2 meters.

The overall average of Qat trees (new and old pattern) grown in Bait al-Khardal per *Libna* is 15.99 (3,264/ha.). In al-Muena'a the numbers are slightly higher with 19.24 trees per *Libna* (3,927/ha.).

Qat trees are trimmed down annually by removing dry, strained or exerted branches, which have been harvested too many times over past years. In this region Qat plants are not usually cut down to ground level (unless they were hit by a cold wave), since it would take about three years for the plant to re-grow to harvesting age.

Once or twice a year the land is ploughed by both, using animals and by hand-plough.

Irrigation

Also during rainy season (March/April and August/September) Qat fields need additional irrigating, but it is especially in the drier period of the year that pumping of water from wells and streams is undertaken on a great scale.

In al-Muena'a region farmers use an average of 3.5 m^3 per *Libna* (714.4m^3/ha.) for each irrigation. Trees are usually irrigated twice per harvest. Two of the 3 harvests

per year two depend on additional irrigation. This means four irrigations a year and thus ١٤ m^3 per *Libna* or ٢،٨٥٧ m^3 per hectare. Trees are usually watered individually to save water.

In contrast to this, in Bait al-Khardal, fields are flooded since water is more abundant. Here and in most other regions visited in Sana'a governorate, Qat is irrigated from deep wells when rain falls short. Cost for such wells that can be ١٨٠-٣٠٠ meters in depth is extremely high. Drilling, pump and pipes costs can amount to YR ١٠ millions (USD ٦٢،٥٠٠). Since cost is so high, wells ownership is mostly collective with ٢-٨ (and sometimes even more) shareholders.

In Bait al-Kharda trees are watered on average with ٣,٥٦ m^3/*Libna* for each irrigation (٧٢٧ m^3/ha.). Irrigation is necessary for ٢ of the ٣ harvests per year (sometimes even for all depending on quantity of rainfall). With irrigations per harvest, this amounts to ٤-٦ irrigations and thus to ١٤,٢-٢١,٤ m^3/*Libna*/year or ٢،٩٠٦-٤،٣٦٠ m^3/ha./year). The average that one may take as a basis for further calculations is around ١٧,٨ m^3 per *Libna* and year or ٣،٦٣٣ m^3 per hectare and year.

When asked for what share of water supplementary irrigation accounts in the total amount of water fields receive per annum (including rainfall) farmers stated that this is about ٤٣ percent (the total amount of being around ٨،٤٦٣ m^3 per hectare and year. Such statements have however to be treated with extreme caution, since farmers have no way to measure how much rainfall their fields receive.

Fertilizer and Pesticide Use

Qat production greatly increased in this area with the help of fertilizers and pesticides. Organic fertilizers application is given much attention since it is rare in the Khawlan district due to an underdeveloped animal husbandry. Chemical fertilizers (like Urea and micro-elements) are used moderately (according to the farmers due to a lack of water).

Pesticides are however used in large quantities (insecticides like Daimthoit, Perfection, Super-Acid, and Dipetrix; fungicides like Topaz and Ropigan). Qat plants are sprays ٣-٤ times per before each harvest, which amounts (with ٣ harvests) to ٩-١٢ pesticide applications annually. Amounts used are ١,٥-٢,٠ cm^3 per ٢٠ liters of water.

e.) From the Field to the Market

Harvesting

Qat is generally picked ٣ times a year. Two pickings (April and September) to some extent on rainfall. A further harvest during dry season (either in June/July or November-January) depends entirely on additional irrigation. However, the picking of small side leaves (*qadar*) is done throughout the year except during periods of extreme draught.

Production Volume

The branches harvested are ٥٠-٨٠ cm in length. They are usually bound into bundles containing ٨-١٥ branches each. The weight of a bundle varies from ٥٠٠-٣،٠٠٠ grams, with and average ٧٥٠ grams in Bait al-Khardal where farmers achieve

average sales prices of YR 810. In Bait al-Khardal tree produces about 7 bundles per year with an average of 16 trees per *Libna* and 3,264 per hectare, this means a harvest volume of 112 bundles per *Libna* and 22,848 per hectare. With an average weight of 750 grams per bundle this is equivalent to 84 kg per *Libna* and 17.1 tons per hectare and year. With an average price of YR 810 per bundle, farmers in Bait al-Khardal achieve an average annual sales price of YR 90,720 per *Libna* and YR 18,506,880 per hectare.

In al-Muena'a a tree produces about 4 bundles per year with an average of 19.24 trees per *Libna* and 3,927 per hectare, this means a harvest volume of 77 bundles per *Libna* and 15,708 per hectare. With an average weight of 500 grams per bundle this is equivalent to 38.5 kg per *Libna* and 7.85 tons per hectare and year. With an average price of YR 294 per bundle, farmers in al-Muena'a achieve an average annual sales price of YR 22,638 per *Libna* and YR 4,618,151 per hectare.

Transportation and Marketing

Different ways of Qat marketing were found in Khawlan district, that apply to all survey areas in Sana'a governorate (they are therefore described only once in the following):

- Qat is harvested by the farmer himself, who directly sells part of his harvest to locally consumers. He then takes the remaining Qat to a smaller market in the region, either by his own car or by a rented vehicle. Such markets are usually situated at crossroads that link roads coming from different Qat growing areas. In such places intermediaries or merchants from the bigger cities buy Qat from the farmer, but also consumer may buy it directly from him.
- In other cases the farmer takes his Qat by own or rented transportation to the bigger cities (in this case Sana'a) where he sells all of his Qat to a merchant, who in turn sells it to the consumers. The farmer may however also sell his Qat himself it the bigger cities to consumers (mostly in small quantities per customer).
- The farmer sells the seasonal output of his Qat trees before harvesting it to an intermediary or merchant who has at his disposal laborers specialized in picking Qat. These laborers come to the farm and pick the leaves under supervision of the farmer. The production is then taken to the market by means of transportation belonging to, or rented by the intermediary or merchant.
- The excellent and thus very expensive kinds of Qat, such as Qat from al-Qabil village (see below), has specialized brokers and merchants that buy this Qat before the harvest and arrange for harvesting themselves. This kind of Qat is bound into large bundles of 3 kg with great attention. Such bundles have specific customers (the Yemeni elite) and they are usually delivered to their homes where they and sold for a very high price, starting at YR 3,000. It is difficult to tell what amounts of his Qat are sold in this way, because it is done with much discretion.

It should be noted that all of the above described ways of Qat marketing depend solely on the farmer's considerations and estimates on how to optimize his income. There are no figures available on how much Qat is sold in the above describes ways.

Qat is sold by the farmer at the farm level either in bundles (*rubta*) or as single branches. The price per bundle varies and may range from YR 2,000-3,000s, depending on seaon, quality, size of bundle and the selling time (higher on holidays and weekends). When taken to the market Qat is also sold in small bags of single leaves (*Qattal*). Weight of these bags may vary from 200-1,000 grams.

f.) Costs and Profits of Qat Production

The Cost for irrigation water is determined by the cost of irrigating labor (see also below), well maintenance, cost of pipes, and maintenance and fuel cost of the water pumps. Taking this into consideration the cost for one cubic meter of water is YR 61.

The amount of water annually given to Qat fields in al-Muena'a region is 14 m^3 per *Libna* or 2,857 m^3 per hectare (see above). Irrigation cost is thus YR 854 per *Libna* and year or YR 174,277 per hectare.

In Bait al-Khardal cost of irrigation is slightly higher since more water is given to the Qat plants. On average (see above) this is around 17.8 m^3 per *Libna* and year or 3,633 m^3 per hectare/year. With a price of YR 61 per cubic meter, this would annually amount to YR1,086 per *Libna* and YR 221,163 per hectare.

Labor cost for irrigating the Qat fields was found in both regions to be the same with 28.7 percent of total irrigation cost, amounting to YR 50,000 per hectare and year in al-Muena'a and to YR 63,400 in Bait al-Khardal. Irrigation of one *Libna* (49 m^2) needs 30 minutes (102.1 hours/hectare (rounded)). In al-Muena'a Qat is irrigated four times a year, annual irrigation times thus amounts to 2 hours per *Libna* and 408.2 hours (un-rounded) per hectare. With 4-6 irrigations per year in Bait al-Khardal, irrigation time is accordingly higher with up to 3 hours per Libna and up to 612.3 per hectare.

Total irrigation cost amounts to 49 percent of annual production cost in al-Muena'a and 39.1 percent in Bait al-Khardal (see table 3).

Irrigation cost per hour (without labor) is thus about YR 304.45, that is for al-Muena'a YR 124,277 annually (408,2 hours) for four irrigations per hectare. With an additional estimated YR 50,000 of irrigation labor cost, this amounts to the total cost of irrigation with YR 174,277 (see table 3).

Labor costs for weeding, Ploughing and trimming are the same in both regions with about YR 35,700 per hectare and year. They account for 10 percent of total production cost in al-Muene'a and 6.3 percent in Bait al-Khardal.

Fertilizer cost was in al-Muena'a YR 20,757 per hectare and annum (5.8 percent of total production cost), quite equally shared by organic fertilizers (YR 10,200) and chemical ones (YR 10,557). In Bait al-Khardal it was double of that of al-Muena'a with a total of YR 41,514 for both kinds of fertilizers (see table 4 for details). This accounts for 7.3 percent of total production cost (Labor cost for fertilizer application is included in irrigation labor cost).

Pesticide and pesticide application cost were YR 53,040 per hectare and annum in al-Muena'a (14.9 % of production cost) and an estimated triple of this amount in Bait al-Khardal (YR 159,120) (28.1 % of total production cost).

Labor cost for pesticide application was below that of Hajja governorate with YR 16,629 for al-Muena'a (4.7 % of production cost) and YR 69,775 for Bait al-Khardal (12.3 %).

Costs for picking and guarding in a-Muena'a around to YR 21,000 and YR 51,000 respectively per hectare and year (5.9 and 14.3 percent of production cost respectively). In Bait al-Khardal they were found to be also YR 21,000 for picking, but much higher for guarding with YR 87,428 (3.7 and 15.4 percent of production cost).

Overall labor cost make up about 49 percent of total production cost in both survey areas. The total cost of labor amounts to YR 174,329 per year and hectare in al-Muena'a and YR 277,303 in Bait al-Khardal.

Production costs for Qat are thus estimated to amount to YR 355,774 per hectare and year in al-Muena'a and to YR 565,925 in Bait al-Khardal.

Table 3: Annual Production Cost of one Hectare of Qat in the al-Muena'a Region

Item	Qat production cost/ha. and year	Percentage of total process	Labor cost in Rials/ha. and year	Percentage of total process
Irrigation	174,277	49 %	50,000	14 %
Weeding/Plough./Trimm.	35,700	10 %	35,700	10 %
Organic fertilizers	10,200	2.9 %	-	-
Chemical fertilizers	10,557	3 %	-	-
Pesticides	53,040	14.9 %	16,629	4.7 %
Picking	21,000	5.9 %	21,000	5.9 %
Guarding	51,000	14.3 %	51,000	14.3 %
Total	**355,774**	**100%**	**174,329**	**49 %**

In al-Muena'a the annual Qat output of one hectare is sold at the market for YR YR 4,618,151 per hectare. After deducting production costs of YR 355,774 and *Zakat* which amounts to 5 percent of the profits (about YR 213,119) the farmer is left with a **net profit of about YR 4,049,258** (for farmers harvesting their qat with own laborers and selling at the farm level).

Table 4: Annual Production Cost of one Hectare of Qat in the Bait al-Khardal Region

Item	Qat production cost/ha. and year	Percentage of total process	Labor cost in Rials/ha. and year	Percentage of total process
Irrigation	221,163	39.1 %	63,400	11.2 %
Weeding/Plough./Trimm.	35,700	6.3 %	35,700	6.3 %
Organic fertilizers	20,400	3.6 %	-	-
Chemical fertilizers	21,114	3.7 %	-	-
Pesticides	159,120	28.1 %	69,775	12.3 %
Picking	21,000	3.7 %	21,000	3.7 %
Guarding	87,428	15.4 %	87,428	15.4 %
Total	**565,925**	**100%**	**277,303**	**49 %**

In Bait al-Khardal the annual Qat output of one hectare is sold at the market for YR 18,506,880. After deducting production costs of YR 565,925 and *Zakat* which amounts to 5 percent of the profits (about YR 897,048) the farmer is left with a **net profit of about YR 17,043,907** (for farmers harvesting their qat with own laborers and selling at the farm level).

C. Taiz Governorate

The total area of Taiz governorate is 11,242 km² (*CSO* 1996). Its population was estimated to be about 2.2 million in 1999 (*CSO* 1999).

Taiz is considered to be the cradle of Qat agriculture in Yemen. Qat is said to have been planted as early as the beginning of 8th century of the Hijra on the Jabel Saber that rises above the city of Taiz. Qat cultivation soon spread from there to the areas of Jabel Habashi and al-Maqatira.

In contrast to areas where Qat cultivation is a new phenomenon, in Taiz governorate farmers were found to have a profound knowledge, handed down from generation to generation, on how to best plant and maintain Qat trees. Farmers are able to stimulate the Qat trees to grow fresh leaves at times they set (even without the use of chemical pesticides used in other areas as growth enhancers). This enables them to achieve greater harvest volumes.

Probably due to the long history of Qat cultivation in this area also many more types of Qat were found to be cultivated here than in other research areas. On Jabel Saber, for example, there were more than six different types of Qat found, that all have different names according to their special features.

Two areas were included in the survey, al-Mesayjid village in al-Maqatira district, and al-Dhowa village in al-Shamaytain district (al-Maqarima sub-district).

Unit Measurement

The traditional land unit of measurement used in Taiz governorate is the *Habal* or *Qassabah*. The Taiz *Habal* equals to 29 m² (ca. 5.39 x 5.39 meters). One hectare is thus equivalent to 344.83 *Habal/Qassabah*.

1. Al-Mesayjid Village (al-Maqatira District)

a.) Topography and Climate

The village of al-Mesayjid located in al-Maqatira district (al-Aqahila sub-district) which is since 1996 part of Lahej governorate. It is located 12 kilometers to the east of at-Turba town and its surroundings lie at an altitude of about 1,400 meters above sea level. The village is situated at the foot of a near vertical mountain-cliff. This area is accessible by a road by passing through the Sharjab region and the "Heijat al-Abid" slope, which is very rough and dangerous to travel on.

The region is characterized by an all year mild climate with rainfall during March/April and August/September. In some years however also during December/January rainfall can appear as a result of heavy fog and cloud gathering carried by westerly winds from the Arabian Sea. The average annual rainfall in this region is 500-600 mm.

b.) Social Characteristics

Data levied from a sample of 10 randomly chosen farmers of al-Mesayjid village revealed that the average family size is 14 persons, of which 7 are male, 7 female.

Land generally is privately owned and an average farming family owns approximately 0.16 hectares (55 Habal) of arable land.

c.) Crop Composition

The fairly small mountain terraces nearby the village are predominantly planted with Qat. The average area of Qat cultivation is about 81 percent of the agricultural area owned by a farming family (0.13 hectare or 44.6 *Habal*). Qat agriculture has a long history in this region, and the age of Qat trees in some cases well exceeds 100 years.

There are also some fruit trees dispersed randomly such as peach, pomegranate guava, and lemon. The however account for only about 2 percent of the agricultural area. Size of agricultural plots in the wadi bed is larger than on its slopes. Different types cereals like fine sorghum, millet and cow pea, grow here (16 % of land area). Also vegetables like fenugreek (*Helbah*), squash and carrot grow here, mostly for home consumption (1 % of land area).

d.) Characteristics of Qat Farming and Production Inputs

Growing Pattern

Despite the long history of Qat cultivation in this area, it is the new growing pattern that is dominant. Qat shoots are grown in a distance of 1:5 m×2.0 m. The trees begin producing harvestable leaves 3-4 years after planting.

The soil in the Qat fields is plowed once a year. The height of Qat trees varies between 2-4 meters. Per *Habal* (29 m^2) 7-13 Qat trees (average 12) were found in al-Mesayjid area. This is an average of 4,138 trees per hectare.

Irrigation

Rainfall is the main source of irrigation in this area, but farmers during drier periods of the year also depend on water from springs and streams. Here water levels depend on rainfall. Wells were not found in this area.

Qat is usually harvested twice and given 2 irrigations before each picking of leaves. A hectare revives about 4,000 m^2 rainwater per year, another 1,863 m^2 are added.

Fertilizer and Pesticide Use

For soil amelioration mostly manures are used according to their availability. Chemical fertilizers (like Urea) are added with much attention and in small quantities (90 grams/tree/year). After fertilizer application irrigation becomes necessary.

Pesticides are used three times before each harvest. They are mainly used to combat pests, such as leaf-worms, and partly also to stimulate and increase growth. The farmers in this region were found to not over-use the pesticides and stay within the limits of what is necessary to keep the trees healthy. They use an average of 1 cm^3

of a pesticide product per liter of water. 20 liters of the solution is enough for 4-5 *Habal/Qassabah* per sprinkle.

e.) From the Field to Market

Harvesting and Production Volume

There are on average two pickings per year. One is the "leaf" picking or "sticks" picking in October, the other the *Mubrih* picking in November. *Each tree produces about 160 branches per year (80 per picking), this is bound into 4 bundles with 40 branches each.* The branches have a length of 20-30 cm. A bundle weighs about 500 grams, which means a tree output of 2 kilos per year.

With an average of 12 trees per *Habal* this amounts to an output of 48 bundles harvested per year with a total weight of 24 kilos. With 4,138 trees per hectare (see above) this amounts to an output of 16,552 bundles and 8,276 kilos per year.

The price the farmer achieves for a bundle is on average YR 232. Qat produced per hectare and year would thus achieve a sales price of YR 3,840,064.

Transportation and Marketing

The Qat is taken to at-Turba town where from where it is sold on commission by merchants that claim 10 percent of the profits. The remaining 90 percent go to the farmer.

f.) Costs and Profits of Qat Production

Qat irrigation costs amounts to YR 162,081 per hectare and year (most being labor - the exact share could however no be determined). Per *Habal* and year this amounts to YR 470. It accounts for 56.8 percent of total production cost (see table 5).

Organic fertilizers make up 2.4 percent of production cost and amount to YR 6,900 per hectare and year. Chemical fertilizer cost is YR 3,450 or 1.3 percent of production cost. Pesticides and cost for their spraying are YR 53,040/ha./year (8.6 % of production cost), of which about 9,600 is labor cost.

Costs for weeding, Ploughing and trimming are YR 16,215 (5.7 % of production cost), for picking an additional YR 9,000 (3.1 %) and for guarding YR 34,500 (12.1 %). The share of labor cost in the total production cost is not known, since there are no figures for irrigation labor available (see table 5).

Table 5: Annual Production Cost of one Hectare of Qat in the Bait al-Khardal Region

Item	Qat production cost/ha. and year	Percentage of total process	Labor cost in Rials/ha. and year	Percentage of total process
Irrigation	162.081	56.8 %	?	?
Weeding/Plough./Trimm.	16.215	5.7 %	16.215	5.7 %
Organic fertilizers	6.900	2.4 %	-	-
Chemical fertilizers	3.450	1.3 %	-	-
Pesticides	53.040	18.6 %	9.600	3.4 %

Picking	9,000	3.1 %	9,000	3.1 %
Guarding	34,500	12.1 %	34,500	12.1 %
Total	**285,186**	**100%**	*69,315 plus irrigation labor*	*24.3 % plus irrigation labor*

The annual Qat output of one hectare is sold at the market for YR 3,840,064. After deducting production costs of YR 285,186 and the merchants commission of 10 percent of the sales price (384,006.4) the farmer has a profit of YR 3,170,872 per hectare and year.

After deducting Zakat which amounts to 5 percent of the profits (about YR 158,544) the farmer is left with a **net profit of about YR 3,012,328**.

2. Al-Dhowa Village (al-Shamaytein District, al-Maqarima Sub-District)

a.) Topography and Climate

Al-Dhowa village is located in al-Shamaytain district (al-Maqarima sub-district) 20 km west of at-Turba town from which it can be reached by a rocky dirt-road. The village lies at an altitude of about 1,400 meters above sea level. Qat is grown in a small water-bed. The area is surrounded by mountains with a water runoff to the west. In the rainy seasons (May-July and August-October) frequently floods occur. Water availability is thus fairly good and rainwater accumulates well in this basin area. The region is marked by a mild climate throughout the year, with an rainfall average of 400 mm/year.

b.) Social Characteristics

Data levied from a sample of 5 randomly chosen farmers of al-Dhowa village revealed that the average family size is 6 persons, of which 3 are male, 3 female. Land generally is privately owned and an average farming family owns approximately 0.13 hectares (44.9 *Habal*) of arable land.

c.) Crop Composition

Qat cultivation is fairly young in al-Dhowa and started only around 1984. Despite this fact today about 31 percent (0.04 hectares per farmer) of the farmland are occupied with Qat.

Besides Qat, also cereals are planted such as different varieties of sorghum (yellow and ghareb), millet, cowpea (vigna), wheat and barely (55 % of area). There are also different types of dispersed fruit trees (14 % of area) like mango, guava and palm trees, which in an intercropping pattern are planted between Qat trees. Fruit production is despite the relative high area share mostly limited to family consumption. Vegetables and fodder where not found in this area.

d.) Characteristics of Qat Farming and Production Inputs

Growing Pattern

In the older fields where Qat was planted in the second half of the 1980s, the distance between trees is about 2×2 m and each *Habal* (29m²) holds on average 7 trees with a height of 2-4 meters (2,414 trees/ha.). In new Qat fields, trees are planted closer to each other (distance of 1×2 m). Each *Habal* holds about 14 plants of 2-4 meters in height. A hectare holds 4,828 trees. The average number of trees in the region (old an new pattern) is about 10 per *Habal.*

Irrigation

Due to al-Dhowa's favorable location in a basin, the area has plentiful of water and can already be found in a depth of 4-6 meters. It is pumped from hand-dug wells by small transportable petrol driven engines. From there water is distributed to the fields by plastic hoses (diameter 2 inches). If the field is too far from the water source or too high up, sometimes up to three pumping engines are lined up and attached to a hose.

Each farmer possesses 1-3 pumps, well ownership is however collective, usually 15-20 farmers possess a well. Fields are irrigated 6 times per year (3 per picking).

One Habal consumes 12 m^3 per annum (2 m^3 per irrigation) that is 4,138 m^3 per hectare annually.

Fertilizer and Pesticide Use

Organic fertilizers are used on a small scale according to availability. Chemical fertilizers like Urea are applied to the trees with each irrigation (average of 100-150 grams/tree/annum). "Iron Shailat" is used once per harvest (twice 3 grams per tree and year). Liquid micro-element fertilizers are mixed with water and sprayed with other chemical pesticides. Qat is sprayed 5-6 times per picking. 20 liters of water mixed with 80-100 mm of pesticide are sufficient to spray 4-6 *Habal* (=116-174 m^2).

e.) From the Field to the Market

Harvesting and Production Volume

Qat is picked from twice a year. The farmer, helped by family members or laborers from the village, leads himself the process of picking the leaves. One harvest is in November-January when trees are deprived of all their leaves in order to obtain later in the year the second harvest (time depending on rains and irrigation) of fresh young shoots (*al-Mubrih* picking) which are of high quality and sold at a very high price.

The branches harvested are 15-30 cm in length (shoots are smaller). They are usually bound into bundles containing 40 branches. The weight of a Qat bundle is about 500 grams. Each tree produces on average 6 bundles (240 branches) per year. With an average of 10 trees per *Habal* this is an output of 60 bundles per year. For one hectare (= 344.83 *Habal*) this would amount to 20,690 bundles (*Rubta*).

Sales price for one Rubta is YR 100-400, depending on season and the quality of the Qat (average YR 270 per bundle). Qat produced per hectare and year would thus achieve a sales price of YR 5,586,300.

Transportation and Marketing

The farmer himself carries out the harvesting of Qat branches with the help of some of his family members and additional labors from village. Qat is transported to the market (at-Turba and neighboring areas) by farmers where it is handed to a retailer who claims a sales commission of 10 percent of the retail value (see below).

f.) Costs and Profits of Qat Production

Qat irrigation costs amounts to YR 168,967 per hectare and year (of which YR 17,000 is labor). Per *Habal* and year this amounts to YR 490. It accounts for 46.2 percent of total production cost (see table 6).

Organic fertilizers make up 1,9 percent of production cost and amount to YR 6,900 per hectare and year. Chemical fertilizer cost is with about YR 6,900 the same. Pesticides and cost for their spraying are YR 106,080/ha./year (29 % of production cost), of which about 42,000 is labor cost.

Costs for weeding, Ploughing and trimming are YR 16,215 (4.4 % of production cost), for picking an additional YR 9,000 (2.5 %) and for guarding YR 51,750 (14.1 %). The share of labor cost in the total production cost is 37.1 percent (see table 6).

Table 6: Annual Production Cost of one Hectare of Qat in the al-Dhowa Area

Item	Qat production cost/ha. and year	Percentage of total process	Labor cost in Rials/ha. and year	Percentage of total process
Irrigation	168.967	46.2 %	17.000	4.6 %
Weeding/Plough./Trimm.	16.215	4.4 %	16.215	4.4 %
Organic fertilizers	6.900	1.9 %	-	-
Chemical fertilizers	6.900	1.9 %	-	-
Pesticides	106.080	29 %	42.000	11.5 %
Picking	9.000	2.5 %	9.000	2.5 %
Guarding	51.750	14.1 %	51.750	14.1 %
Total	**365,812**	**100%**	**135,965**	**37.1 %**

The annual Qat output of one hectare is sold at the market for YR 5,586,300 (see above). After deducting production costs of YR 365,812 and the merchants commission of 10 percent of the sales price (YR 558,630) the farmer has a profit of 4,661,858 per hectare and year.

After deducting Zakat, which amounts to 5 percent of the profits (about YR 233,093) the farmer is left with a **net profit of about YR 4,428,765**.

IV. Summary

The survey focused on three Qat growing governorates, Hajja, Sana'a, and Taiz. Altogether 79 randomly chosen farmers were interviewed (Hajja 21, Sana'a 33, and Taiz 25), including small, medium and big Qat farmers.

In **Hajja Governorate** two areas where chosen, that of **al-Mahabesha district**, a focus was set on ar-Rasa'a village and the **Najara district** with Dawas village. Al-

Mahabesha is famous for the *al-Shami* qat, one of the best and most expensive in Yemen. *Najri* qat from Najara area is of less quality.

In **Sana'a Governorate** the district of **Khawlan** was chosen with the villages Bait al-Khardal and al-Muena'a. While the village of al-Muena'a was chosen for its dependency on irrigation via springs streams, floods and surface wells as well as its average quality qat, Bait al-Khardal was chosen due to its good quality Qat and its dependency on deep wells for Qat irrigation.

In **Taiz Governorate** the **al-Maqarima** area was selected because of its medium quality Qat and its dependency on hand-dug shallow wells. **Al-Maqatira** region was chosen because it grows one of the finest Qat in the southern part of Yemen, dependent on irrigation by rain, springs, wells and water basins.

Results

Land ownership was found to be private in all survey areas, the farmers cultivating the ground were found to be its proprietors.

Average farm size was found to be 0.84 hectares. It was considerable lower than the average in al-Dhowa with only 0.13 hectares, and much higher in Bait al-Khardal with 1.95 hectares (see table 8).

Crop Composition

Qat cultivation was found to occupy 54.6 percent of a farmer's arable land in the survey areas. It was extremely high in Rasa'a with 95 percent, and quite low in al-Muena'a and al-Dhowa with 30 and 31 percent respectively.

Second to Qat cultivation were cereals with and average of 32.3 percent of land share, followed by fruit (6 %), vegetables (2.9%) and fodder with only 0.3 percent.

Fruit trees were found in a quite considerable number in al-Muena'a and al-Dhowa with 12 and 14 percent of land share respectively.

In the Dawas region a large share of un-arable land was found accounting for 19 percent of farmers properties, this is most likely due to rural urban migration. Farming families are not able anymore to cultivate all their land due t labor shortages (see table 7).

Table 7: Area Share of different Crops in the Survey Regions (in Percent).

Region	Qat (in %)	Fruit	Cereals	Vegetables	Fodder	Unarable Land	Total
Dawas	36 %	0.5 %	44 %	0.5 %	0.5 %	19 %	100 %
Rasa'a	95 %	1.5%	1.5 %	1 %	1 %	0 %	100 %
al-Muena'a	30 %	12 %	45 %	12 %	0 %	0 %	100 %
Mesayjid	81 %	2 %	16 %	1 %	0 %	0 %	100 %
al-Dhowa	31 %	14 %	55 %	0 %	0 %	0 %	100 %
Average	54.6 %	6 %	32.3 %	2.9 %	0.3 %	3.8 %	100 %

It must be said that the figures in the above table are not representative for the entire surveyed governorates; figures on Qat are thus no governorate average. This is since only regions were chosen that grow Qat. Others without Qat or only small scale Qat agriculture were for this study of minor interest

Growing Pattern

Qat is grown in different patterns, old ones usually leave the trees more space, there are thus less trees per unit area. Also trees are often not planted in a determined pattern in older fields. In younger fields they are usually planted in rows, and the space between trees is uniform.

The average number of trees (for old and new pattern) found per hectare is 3,956. Numbers were lowest in Bait al-Khardal with 3,264 trees/ha. And higher up to 5,101 trees/ha in Dawas (see table 8).

Irrigation

Qat fields are in most regions not irrigated all year round, since during the summer and autumn months rain is abundant, and mostly sufficient. During the rest of the year additional irrigation is however necessary. Fields are irrigated several times before the harvest (average of 3 times), to stimulate leaf growth.

Irrigation water is either pumped from machine drills deep wells, from shallow hand dug wells, from cisterns, or from streams. In case there is not sufficient water in the area additional water has to be bought, which is brought by truck from the valleys. A truck usually transports 10 m^3, which is sold an average of YR 900-1000.

High prices have led farmers to use water carefully and avoid its overuse. Too much water is not good for qat plants and produces low quality qat leaves that lack taste.

Fertilizer and Pesticide Use

Farmers use both organic and chemical fertilizers. Amounts vary greatly from one farm to the other. Fertilizer is usually applied just before irrigation so that it can reaches the trees' root fast and to avoid that it is carried away by the wind.

Another method of enriching the fields is by adding fertile soil taken from other areas once a year.

In order to protect the Qat plants from pests, various types of chemical pesticides such as Drobihun, Mitathun, Super, Depretix, Fistax and, Parvtoti are applied.

Also organic pesticides are used in Qat cultivation, among them are Pavestine and Topaz that are applied in order to increase Qat growth and thus output. Random use of pesticides and various kinds of chemical fertilizers without adequate safety measures was frequently found. Sometimes even children (12-15 years old) carry out the spraying. Many farmers also do not respect a safety period and spay pesticides until the harvesting of leaves. Chewers are thus directly exposed to these chemicals. Times and frequency of pesticide application vary greatly from one farmer to the other.

Harvesting

Qat is picked on average 2.9 times per year. In Rasa'a it was higher with up to 5 times annually, in al-Mesayjid and al-Dhowa it was lower with 2 harvests per year. The number of harvests is dependent on rainfall and the ability of farmers to afford water transported by truck to the fields. Pickings in March/April and August/September depend mostly on rainfall. During other times of the year additional irrigation is needed (see table 8).

Production Volume

Production increases during the dry and hot summer months and decreases during the colder months of winter and autumn (but during the latter two producing a better quality).

Qat is picked at varying lengths of between 15-50 cm. The branches are tied in small bundles with a weight of 376-750 grams (average 521 g).

Per year a Qat tree produces between 4 and 9 bundles (average 6.3). In Rasa'a it was found highest with an average of 9 bundles, in Dawas and al-Muena'a with 4 bundles.

With an average of 3,956 trees per hectare with each producing an average of 6.3 bundles, this amounts to 24,923 bundles per year and hectare. Numbers of bundle output were greatest in Rasa'a with 34,704 per hectare and year, and lowest in al-Mesayjid with 16,552.

The price the farmer achieves for a bundle of Qat also greatly varies by region and is principally dependent on climate and quality. The average bundle price was found to be YR 399, but was higher in Bait a-Khardal with YR 810 and lower in Dawas with YR 222.

When multiplying the sales price with the number of bundles produced by a hectare, plantation output amounts on average to YR 9,459,746/ha./year. Also her considerable differences were found from one region to the next. In Rasa'a where the well known and expensive *Shami* Qat is produced it was highest with YR 19,677,168, and with one fifth of the latter lowest in al-Mesayjid with YR 3,840,064 (see table 8).

Table 8: Qat Farming at a Glance

	Hajja		Sana'a		Taiz		
Item	Dawas	Rasa'a	Al-Muena'a	Bait al-Khardal	al-Mesayjid	al-Dhowa	Average
Farmland per family (in ha.)	0.8 ha	0.6	1.42	1.95	0.16	0.13	0.84 ha
No of harvest/year	3	4-5	3	3	2	2	2.9
No. of trees/ha.	5,101	3,856	3,927	3,264	4,138	3,448	3,956
Bundles/tree/year	4	9	4	7	8	6	6.3
ndles/ha/year	20,405	34,704	22,638	22,828	16,552	20,690	22,970
Bundle weight	376 g	500 g	500 g	750 g	500 g	500 g	521
Bundle price	222 YR	567 YR	294 YR	810 YR	232 YR	270 YR	399
Production output/ha/year	4.529.910	19.677.168	4.618.151	506.880	3.840.064	5.586.300	9,459,746

Costs and Profits of Qat Production

Plantation output is however not what the farmer earns. His profit is determined by the height of production cost, Zakat tax and in some cases by commissions taken by merchants.

Production cost for one hectare of Qat was found to average YR 581,526. It was found highest in Rasa'a (YR 1,114,934) and lowest in al-Mesayjid (YR 285,186).

In most areas water makes up the highest share of production cost (40.8 %). It averages YR 237,203 and was found highest again is Rasa'a (YR 576,000) and lowest in Dawas (YR 120,730) (see table 9). A great share of this (one third to one half) is labor cost, the rest being cost for pumping (gasoline), pump maintenance, and water. Irrigation labor cost includes labor for fertilizer application since this is done simultaneously.

Fertilizers (organic and chemical) cost the farmer on average YR 28,292 per hectare (4.8 percent of production cost). It is highest in Rasa'a with YR 64,564 and lowest in al-Mesayjid with 10,350 Rials per hectare and year.

Labor costs for weeding, Ploughing and trimming accounts for another 13.9 percent of the production process and amounts on average to YR 80,955 per hectare and year. It was found to he highest in Hajja governorate and lowest in Taiz (see table 9).

Pesticide cost and cost for spraying account for 21.1 percent of production cost and amounts to about YR 122,933/ha./year. In Rasa'a the highest pesticide expenditure was found with YR 184,320. In al-Mesayjid and al-Muena'a it was lowest with YR 53040 each.

Costs for picking and guarding amount to YR 57408 and YR 54,744 respectively per hectare and year or to 9.9 and 9.5 percent of the total production cost. Costs for picking were found to be exceptionally high with up to 18 times the Taiz labor costs. This could hint to wrong statements by farmers in the Hajja area (see table 9).

Table 9: Annual Production Cost of one Hectare of Qat in the Survey Regions

	Hajja		Sana'a		Taiz			
Item	Dawas	Rasa'a	al-Muena'a	Bait al-Khardal	al-Mesayjid	al-Dhowa	Average	Percent
Irrigation	120.730	576.000	174.277	221.163	162.081	168.967	237,203	40.8 %
Weed./Plough./Trimm.	225.100	156,800	35.700	35.700	16.215	16.215	80,955	13.9 %
Organ. fertiliz.	21.150	12.000	10.200	20.400	6.900	6.900	12,925	2.2 %
Chem. Fertiliz.	7.617	42.564	10.557	21.114	3.450	6.900	15,367	2.6 %
Pesticides	182.000	184.320	53.040	159.120	53.040	106.080	122,933	21.1 %
Picking	169.200	115.250	21.000	21.000	9.000	9.000	57,408	9.9 %
Guarding	75.785	28.000	51.000	87.428	34.500	51,750	54,744	9.4 %
Total	801,582	1,114,934	355,774	565,925	285,186	365,812	581,526	100 %
Governorate Average	958,258		460,850		325,499		581,526	

Per hectare and year plantation output is on average YR 9,459,746 (see table 10). After the deduction of production cost (YR 581,526) and Zakat the farmer is left with a net profit of about YR 8,285,049 per hectare and year.

This means that the ratio of production cost (YR 581,526) to profits (YR 8,878,220.) is 1 : 15.3 - for Bananas it is 1:1, sometimes 1:2.

Table 10: Annual Production Output, Cost, Tax Payments and Net profits of Qat Farmers in the Survey Regions (per Hectare).

	Hajja		Sana'a		Taiz		
Item	Dawas	Rasa'a	al-Muena'a	Bait al-Khardal	al-Mesayjid	al-Dhowa	Average
Production output/ha/year	4,529,910	19,677,168	4,618,151	18,506,880	3,840,064	5,586,300	9,459,746
Production Cost (YR)	801,529	1,114,934	355,774	565,925	285,186	365,812	581,526
Zakat (YR)	186,416	928,112	213,119	897,048	158,544	233,093	436,055
et profits (YR)	3,541,912	17,634,122	4,049,258	17,043,907	3,012,328	4,428,765	8,285,049

Average net profits her hectare are YR 8,285,049. However, land possessions of farmers are much smaller than a hectare. On an average for all survey regions they are 0.84 hectares (see table 8). Of this area only 55.6 percent (without Bait al-Khardal (see table 4) are planted with Qat. Thus, a Qat farmer cultivates on average on only 0.47 hectares Qat. The annual net profit produced by this area would be YR 3,893,973.

Recommendations

Qat demand is likely to increase over coming years due to population growth and an ever-increasing share of the population that embraces this habit. Thus, in coming years the Qat issue must be given adequate attention by the government by:

- Strengthening and developing the Qat Research Unit in order to enable it to conduct its tasks (study of Qat cultivation, trade and consumption, and impacts thereof on environment, natural resources and the society) and help it to become the National Center for Qat Research.
- Determining the actual area of Qat cultivation by aerial photography, remote sensing, and ground surveys and by using the experience of the Qat Research Unit in this field
- Determining the number of farmers involved in the overall Qat production.
- Making the issue of Qat a permanent focus of future agricultural censuses.
- Raising awareness among farmers on water depletion and preservation.
- Developing and introducing new irrigation techniques (e.g. spot sprinkler irrigation) in order so save water and making these techniques available to farmers for affordable prices.

- Conducting awareness campaigns on the harmfulness of pesticides to human health and the environment, as well as on the proper and timely use of fertilizers.
- Developing and introducing new (natural) pesticides that are less harmful and could replace the highly toxic pesticides used by farmers currently.
- Enforcing laws on the import of pesticides in order to limit the use of harmful substances by farmers.
- Introducing new crops into the farming process as an alternative for Qat in the various environments in which it is grown (such alternatives should chosen according to marketing possibilities).
- Creating new jobs and opportunities in the countryside to keep the population from migrating to the cities, once Qat agriculture is abandoned or reduced.
- Revising the current Qat taxation system since until now Qat taxation is only carried out unsatisfactorily with great revenue losses for the state.
- Conducting pharmacological studies on Qat in order to find ways how to use Qat ingredients in pharmaceutical products.

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i This is Sana'a governorate before the carving out of Amran governorate.