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Proceedings of the

EXPERT CONSULTATION ON LAND DEGRADATION, PLANT, ANIMAL AND HUMAN NUTRITION: INTER-RELATION AND IMPACT

Damascus, Syria
20-23 September 2003

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TABLE OF CONTENTS

Page

FOREWORD

The FAO Regional Office for the Near East operates with a clear focus on the sustainable utilization of Natural Resources. Due to the obvious decreasing trend of arable lands available for agricultural production, the vertical expansion becomes an obvious option for enhancing agricultural and animal products. The Human Food Chain, evidently is depending on the two basic sources of food (animals and plant commodities). It follows, therefore, that plant, animal and human nutrition issues are closely inter-related. It is widely recognized that there is a continued demand pressure on food due to the increased population and economic growth of societies. With the low overall arable lands availability in the Near East Region (0.2 ha per capita), coupled with an accelerating trend of land degradation, the vertical growth in agricultural outputs becomes imperative. Provision of adequate plant nutrients through adding the appropriate amounts and forms of fertilizers (whether chemical, organic or biofertilizers) became essential practices and their positive role is fully recognized for securing healthy plant and animals products. It is interesting to mention here that although Selenium (Se) is not an essential plant nutrient, yet it is so for animals. Its application to the rangelands in Europe is now being practiced for the purpose of having healthy grazing animals.

The current volume presents the Proceedings of an important meeting entitled *"Regional Expert Consultation on Land Degradation, Plant, Animal and Human Nutrition: Inter-relation and Impact"*. This scientific gathering managed to have a group of soil scientists/plant nutrition specialists, animal nutrition and medical doctors/human nutrition specialists to discuss these inter-related issues.

The new sphere of knowledge on Plants, Animals and Human related issues and concerns is needed to allow an interchange of country experiences regarding this triangular intricate relationship. This would encourage countries to develop their own national guidelines for "rules and regulations" necessary to organize the activities/procedures including better application of the agronomic Good Agricultural Practices (GAP), as well as the strengthening of national capacities for the adherence and following the FAO/WHO Codex Alimentaris.

Hope that the present document would initiate the dialogue among all concerned to start managing the Region natural resources in an integrated and holistic manner for the sustainable and efficient utilization of these valuable resources.

Mohamad Albraithen

Assistant Director-General and
Regional Representative for the Near East

INTRODUCTORY REMARKS

ORGANIZATION

The Expert Consultation on "Land Degradation, Plant, Animal and Human Nutrition: Inter-relation and Impact" was held in Damascus, Syria (20-23/9/2003) in cooperation between FAO Regional Office for the Near East – RNE (Cairo) and FAO/AGLL (Rome); as well as SESRTCIC (Ankara).
Participants included members from following countries: Egypt, Islamic Republic of Iran, Jordan, Lebanon, Morocco, Oman, Sudan, Syria, Tunisia, and Turkey.

INAUGURATION OF THE EXPERT CONSULTATION

The meeting was inaugurated by Dr. Mahmoud Taher, FAO / Representative in Syria on behalf of the FAO Regional Office. Dr. Taher welcomed the participants and highlighted the role of FAO for its continuous efforts in the development of agriculture in the Region, and in sponsoring such important consultation in Damascus. He also thanked the cosponsoring organizations whose contribution was much appreciated. Dr. Taher stressed the importance of giving more attentions of Land Degradation, Plant, Animal and Human Nutrition for the next decades.

BACKGROUND

The last few decades witnessed a growing public awareness on food quality and the intricate association between agronomic and animal products that go in the human food chain. A good deal of international efforts are directed to regulate, control and ensure the safety of human food items through legislation and introducing standards and specification codes, for which the famous FAO Codex Alimentaris is a vivid example of this global endeavor. Because soils are the natural base for growing crops and raising animals; then it is imperative that its fertility will impose the quality and mineral content of such agricultural products. It is well known that nutrient deficiencies in soils are reflected not only on crop yields, but also on their contents of mineral nutrients. Food and animal feed, containing low amounts of nutrients, would lead to mineral deficiencies in animals and humans. On the other hand, some serious diseases are common to humans and animals, like the BSE, which is basically an animal nutrition–based problem.
Almost in all Near East countries, soils are characterized by their calcareous nature, alkaline pH, low organic matter, and inherent low levels of minor elements (Fe, Mn, Cu, and Zn), which would have its consequent effect on crops, animals and humans. It was observed that Fe and Zn deficiency in humans are more widespread in the Region; while Mn and Cu deficiencies are showing deficiency symptoms on farm animals. Although Selenium (Se) is not an essential plant nutrient; it is so for animal nutrition, and therefore, it' is becoming a very important element in this respect. Several studies reported in literature indicated that the deficiency in Se in human bodies was related to more exposure to prostate cancer. Other studies pointed out that Zn deficiency could have its serious negative impact on the human body.
There are very rare and sporadic efforts in the Region to bring together scientists working in these various disciplines (soil science/plant nutrition, human nutrition,

10- Research and extension programmes, in most countries of the Region are facing real constraints related to weak linkages between the two; in addition to the severe limitations of funds and other resources.

Conclusions of Group II: Animal Nutrition and Health

1- The need is obvious for extending research and studies related to optimal animal nutrition requirements to include conformity with established feed standards and taking into consideration the feed quality and its effect on the content and quality of milk and meat products.
2- There is a definite need for adoption of appropriate principals of animal nutrition and technology for producing value-products for human consumption, particularly protein and fat contents of animal products.
3- Most countries lack the technology and legislation for quality control, methods for analysis of animal products to conform with international standards, such as Codex Alimentarius.
4- National and regional programmes for the Region are necessary to target improving the productivity and quality of animal products, with emphasis on training of cadres, diversification of production systems like small animal keeping (chicken, rabbits etc.) on the farm back yard.
5- Small scale producers are facing poor extension assistance and often are confronted with low market prices due to lack of processing facilities and market access, leaving a room for co-operatives to provide some needed services.

Conclusions of Group III: Human Nutrition and Health

1- The need to emphasize the quality of crops, particularly in relation to having adequate micronutrient contents; as well as to ensure year-round supply and availability of such products.
2- A good diversity of regionally acceptable and accessible crops is required to cover the whole spectrum of human micronutrient needs.
3- Some regional committee or association is essential to study and coordinate assessment studies on bio-availability of micronutrients in plants, animals, and human, to ensure the increase of enhancers and decrease of inhibitors in human nutrition.
4- A Web-based discussion group or a Network for the Region is necessary to facilitate communication and exchange of knowledge within the Region; as well as with other relevant organizations to ensure an integrated approach to this inter-disciplinary area for the evaluation of plant, animal, and human nutrition problems and study their intricate inter-relationships.

RECOMMENDATIONS

1) Conducting research programmes on fertilizer use rates, formulas, types, application methods, their impact on quality of the product; need to be strengthened, properly-designed, well-targeted, and co-coordinated with other disciplines of animal and human nutrition.
2) Improvement of micronutrients (especially zinc and iron) nutritional status in plants, animals and humans. Also studying the use of other nutrients such as S, Mg, and Ca should all be strengthened.
3) Using heavy isotope tracer techniques provides a good tool for fertilizer tracing and utilization efficiency studies.
4) Encouraging organic agriculture (for an added-value to products) and for the production and use of bio-fertilizers including mycorrhiza, thiobacillas and azotobacter bacteria, etc.
5) Review and develop fertilizer legislation and a national code of practice for each country that includes chemical and organic fertilizers, as well as for soil amendments and plant nutrition enhancement agents.
6) Promote the free movement and exchange of fertilizer products between countries of the Region.
7) Emphasis should be given to study the impact of fertilizers on crop quality under protected systems and pressurized irrigation.
8) Soil and water quality should be monitored regularly to assess any pollution risks to the environment.
9) Maintain Effective linkages between institutions with the Land Degradation Assessment Programme (LADA) should be established to protect the Region's limited resource base.
10) Encourage the integrated team work among researchers in plant nutrition, animal and human nutrition and health, at both national and regional levels for evaluating the effect of balanced fertilization on plant yield increase and on produce quality, and its direct bearing on enhancing animal and human nutrition and health.
11) Call on more co-operation between the Near East countries and the relevant regional and international organizations concerned with the above issues and concerns, particularly FAO, UNICEF, and WHO, for co-sponsoring of joint projects.

I
Consultation Papers

Plant, Animal and Human Nutrition: *An Intricate Relationship*

1. INTRODUCTION

The Near East Region, covering 30 countries, is faced with many constraints related to: limited arable lands per capita (about 0.22 ha); severe water shortages (16 countries below the deficiency level of 500 M^3/capita of annual renewable water resources); poor soil fertility; low investments in land and water projects; non-adequate prices for agricultural commodities and poor or failing marketing systems. The marked role of chemical fertilizers was acknowledged by several FAO publications and was reported that over 55% of the increase in agricultural production was mainly ascribed to the fertilizers use (FAO, 1997). Fertilizer use becomes a must in producing economically-feasible crops and for improving food security in many countries. Although the use of fertilizers started over a 100 years in the Region, by using a small portion of Chilean Nitrate; the correct usage of those fertilizers still has a long way to go on the right track. The Near East countries are currently using around 8.5 million tons of fertilizers, with the big share goes to Nitrogen. The phosphatic fertilizers are used at a smaller rate and then the potassium, if remembered. The minor elements (micro-nutrients) are used at even smaller quantities, in a random manner and hardly well-considered in the fertilization programme. Perhaps, in green house production and in some modern farms such consideration is given to all essential elements of plant nutrition, including the minor elements. Since plants constitute the basic feed item for animals; then it follows that a healthy and balanced plant produce, in terms of its nutrients content and quality, would make it an appropriate healthy item to meet the animal nutrient requirements. Some dramatic cases of deficient animal feed were responsible for some ailing animals which were difficult to relate to any known animal disease. The Selenium (Se) deficiency in the forage crops raised on pure sandy soils in the Kafra Project in Libya in the late 1970s was a puzzle to solve until it was investigated and found to be stemmed from the low Se content in the forage fed to animals, which was due to its low content in those desert sandy soils. The Region witnessed three Meetings (held in Egypt, Jordan and Syria) during the last few years that were dedicated for discussing the current concerns of food quality and its content vis-a-vis its impact on human nutrition and health, particularly in children. The saying "Agriculture is the Guardian of Health" is a correct one, to the extent that food quality –being the basis of human and animal health- depends on the correct use of means of crop production, specially fertilizers. This paper would try to focus on the intricate relationships between plant nutrition, animal nutrition and the impact on food chain for humans.

2. BASIC SOIL-PLANT RELATIONSHIPS

2.1 Essentiality of Plant Nutrients

Soil is the cradle for growing plants and raising animals. Plants require some *17 essential elements* in order to grow healthy and produce economic crops. Some of these elements are abundantly available from air or water (C, H, O); others which are needed in relatively large amounts, and thus called *"Macro-nutrients"*, can be absorbed from soil solids (N, P, K, Ca, Mg, S). The rest, which are also essential for plants but at lower rates and thus called *"Micro-Nutrients"*, exist in the soil solids (Fe, Cu, Mn, Zn, B, Cl, Mo, and Co). Other minor/micro-nutrients such as Na, Fl, I, Si, Sr, and Ba were cited to have positive impact on crop growth. From the 17 elements listed above, it's clear that the majority of them are essential nutrients for both plants, animal and humans, though at various forms and with different doses and growth stages of

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each living organism. Selenium, for example is not essential for plant but it is essential for animals and human health.

Not only the total content of a specific element is important, but also its chemical form and its relative concentration with other certain related elements in the soil solution. Therefore, it is significant in studying the soil and plant fertilizer programmes to identify the availability of plant nutrients by characterizing the various occurring chemical forms of the element: *soluble, exchangeable; fixed and total,* in addition to the element concentration or content.

2.2 Balanced Fertilization

For plants to successfully absorb nutrients; some conditions are required including: adequate element concentration; appropriate ratio of concentration in relation with other certain elements; in addition to existing favourable soil atmosphere (like soil aeration, suitable pH, well-developed rooting system; and adequate water supply, etc.). The three basic *"fertilizer elements"* (NPK) constitute the bulk of chemical fertilizers produced and utilized, are required at certain levels that vary according to each crop and to its growth stage. There is ample evidence from literature that describes the importance of having favourable ratios of concentration such as N/P; N/K; Ca/P; P/Zn; Fe/Mn; Fe/Zn; and so on. However, several studies in the Region concluded that to maintain successful crop production, the 3 main fertilizer elements (NPK) need to be applied at this ratio: 5:2:1. The statistical data from the Region indicate that the current use of (NPK) is around 5:1:0.5. The dominance of Nitrogen used is due to its relatively lower prices and to its quick observable results on the plant vegetative growth. The existence of several N-producing Chemical Fertilizer Factories throughout the Near East (both for urea and other ammonium compounds) perhaps contribute to the favourable use of N. On the other hand, the bias against the use of Potassium is clear. It' is quite indicative to point out that in the whole Region; only *one factory for producing Potassium Chloride* (Muriate of Potash) exists in Jordan, with a capacity of about 1.5 million tons/year. Perhaps another reason for the low level of K fertilizers used is the general concept that soils of the Region do contain ample supply of potassium. Although this remark might be partly true; but the intensive cropping of lands would deplete those original reserves in the soil. It is worth noting that Nitrogen Manufacturing Complexes exist in almost all Gulf Countries (basically due to the abundant supply of natural gas); in addition to: Egypt, Turkey, Iraq, Syria, and others. Phosphorus producing factories exist evidently in those countries where the P deposits and rock phosphates occur, such as Morocco, Tunisia, Iraq and Jordan.

However, a balanced fertilization programme should also include the micro-nutrients and not only the above-mentioned macro-ones. It is clear from the Fertilizer Consumption statistics of the Region countries that these minor elements are not given the due consideration and attention they deserve. Therefore, hunger signs and deficiency symptoms due to insufficient application of these micro-elements are wide spread in the Region. The paper to be prèsented by El-Fouly in this Consultation would shed more light on this area of plant nutrition.

3. PLANT AND ANIMAL PRODUCTS: THE HUMAN FOOD CHAIN

3.1 A Global Concern on Food Safety

The last few decades witnessed a growing public awareness on food quality and health, reflected by recognizing the need for standards for agronomic and animal products that constitute the human food chain. Similar concerns include worries about the use of irradiation in food preservation and biotechnology in food production (GMO's); as well as diseases linked to intensive animal farming and increased international trade. A good deal of these global efforts are directed to regulate, control and ensure the safety of human food items through legislation and introducing standards and codes of practice, for which the famous *Codex Alimentaris* is a vivid example of these endeavours. This FAO and WHO joint Commission is charged with setting of

food and agricultural safety and trade standards. As concerns rise about the safety of the food chain; the 26th. Session of the Commission convened at FAO, Rome in July' 2003, bringing together some 600 worldwide experts in food safety and agricultural trade. The objective was to adopt new food safety and trade standards and to upgrade others based on the latest scientific information available. The Commission adopted more than 50 new safety and quality standards, some new guidelines and others that are revisions of old standards. The guidelines cover food safety, not environmental risks and include pre-market safety evaluations, product tracing for recall purposes, and post-market monitoring. They cover the scientific assessment of genetically-modified plants (GMO's); as well as establishing broad general principles to make analysis and management of risks related to biotech foods uniform across Codex's 169 member countries.

Because soils are the natural base for growing crops and raising animals; then it is imperative that its fertility will impose the quality and mineral content of such agricultural products. Therefore, nutrient deficiencies in soils are reflected not only on crop yields, but also on their contents of mineral nutrients. Food stuffs and animal feeds, containing low amounts of nutrients, would lead to mineral deficiencies in animals and humans. On the other hand, some serious animal diseases of real concern to humans, like the Mad Cow Disease (BSE), are basically animal nutrition–based problems.

There were rare occasions in the Region when scientists working on various disciplines like (soil science/plant nutrition, human nutrition, veterinary/animal nutrition, as well as, medical sciences), would convene to study the inter-related problems and concerns of these domains. Only a multi-disciplinary approach to study those areas would produce plausible remedies to the nutrients imbalance and deficiencies in the human diet, that can be best offset by treating those deficiencies in plants and animals. To deal with the potential problem at the *point source* would be more effective and feasible than addressing the risk later through some *additives or fortification programmes.* It should be noted that some studies related to *genetic manipulation* are targeting the production of major crop plants for both human and animal consumption with nutritionally enhanced macronutrients, improved fatty acid and essential amino acid composition; as well as improved micronutrients such as vitamins and minerals to address nutrient deficiencies.

3.2 Fertilization and Product Quality

The crucial problem with food quality is whether the food produced with conventional fertilization (organic-based fertilizers) is always higher in quality (both in nutritive value and commercial quality). Since the use of fertilizers becomes a reality and necessity in crop production; the challenge becomes then to prove that the *increased produce in not on the expense of quality.* This concept also stems from the *"Value of Naturalism; what is natural is good; and what is un-natural and artificial is not good".* This argument was behind the bias against the use of synthetic chemical fertilizers, and even to group fertilizers with other agricultural chemicals (pesticides which are basically poisons to animals and humans). This led to some public confusion and even certain governmental legislation to discourage or limit the use of commercial mineral fertilizers. This argument could be faced with the fact that *both phosphate and potassic fertilizers come from "natural deposits"*, which are only slightly processed to produce them in a more available chemical form to be absorbed by plants. It should be noted here that plants don't *prefer* their nutrient, say nitrate, to come from an organic source rather than a chemical one, as other forms of N are converted to NO_3 when absorbed by plants.

The new trend of promoting *"Organic Agriculture"* is claiming a considerable deal of acceptance and recognition, and FAO designated that as on of its PAIA's (priority areas for interdisciplinary action) with an Inter-Department Working Group in Rome and a website. Of course, organic food products are marketed easily and at higher prices and many countries in the Region started developing plans for expanding this approach, with real big and sometimes exaggerated hopes and expectations. No doubt that *Organic Products* attract customers and bring beneficial return to growers; yet this mode of agricultural production can't possibly be a corner-stone for crop production. Because it hardly represent 2% out of the overall production in American agriculture; then it can't be a strategy for agriculture production, in the general sense. Its great potential can be attached to some *selected high-vale cash fruits and vegetables* and perhaps medicinal plant products. The Arab Organization for Agric. Development and FAO are sponsoring a Conference in Sept 2003 in Tunisia to review the progress in the Region countries of the move towards Organic Farming, and to discuss the required accreditation, regulations and standards that regulate this type of farming practices.

4. PLANT, ANIMAL AND HUMAN NUTRITION: AN INTRICATE RELATIONSHIP

4.1 Background

Full-value food is an essential precondition for health of humans and animals. Links between plant nutrition and the quality of vegetal foodstuffs is well established. Almost one half of all human diseases are caused directly or indirectly by in correct or in adequate nutrition (Finck, 1982). Both in regions of short food supply and abundant food production; producing foodstuffs of desirable quality is required to ensure healthy food for consumers and good return for producers. Sufficient supply of N and P is essential for protein synthesis in plants. Potassium is needed for carbohydrate formation, and other minor elements, such as Fe, Mn, Cu and Zn, play key role in all biological processes of organisms.

Almost in all Near East countries, soils are generally characterized by their calcareous nature, alkaline pH, low organic matter, and inherent low levels of N and P as well as the minor elements (Fe, Mn, Cu, and Zn). Lime-induced chlorosis, mainly due Fe and Zn deficiency are common and can be easily observed in fruit tree-orchards in the Region (El-Fouly; 1997). Therefore, the supplementation of such soils with the deficient elements is a necessity to grow healthy plants. In animals, Mn and Cu deficiency symptoms can also be observed. It became a practice in Europe to spray Selenium compounds on range land for the benefit of grazing animals. Bashour (2001) conducted some pioneering studies in the Region by assessing the Se level in soil samples collected from various countries in the Near East, and found those levels are marginal. Luckily, soils of the Region are inherently low in phosphorus (P) which would obligate farmers to add P fertilizers that contain some impurities of Se and thus compensate for the soil Se deficiency. Other studies pointed out that Zn deficiency could have its serious negative impact on the human body (Malakouti, -------).

A good example of this category is Selenium (Se), and due to its important role, below is a brief discussion on this vital nutrient.

4.2 Critical Role of Selenium

Selenium (Se) is both toxic and beneficial to plants, animals and humans. Although it is not an essential plant nutrient; it is so for animal nutrition. Selenium then is becoming an important element to reckon with in plant nutrition (for the animal benefits).The relatively high concentration of Selenium in some phosphate rocks is significant for agriculture because of the wide use of phosphate fertilizers manufactured from these deposits. It has been suggested that normal super-phosphate can be expected to contain about 60 % as much Selenium in the original rock. However, Se could be toxic at concentration that exceeds 10 parts per million (ppm). Since the 1950s, a large research effort was spent on Se in Europe, U.S. and other countries, but very minimal work has been done in this Region, and the essentiality of Selenium for animals was discovered in 1957. The biochemical functions of Selenium that are currently recognized include its role as a component of glutathione peroxidase in animals. This enzyme appears to protect tissues against peroxidation. The metabolic interrelationship of this enzyme with vitamin E is particularly evident in deficiency-related diseases that can be prevented either by vitamin E or

Selenium. Signs of Selenium deficiency are frequently indistinguishable from those of vitamin E deficiency. Depending on the species, these symptoms include: liver damage, pancreatic enlargement, anaemia, elevated serum bilirubin levels, dermatitis, hair loss, and abnormal hooves and nails may also be seen. While the normal range of Se consumption can range from 0.03-0.5 mg/kg of dry matter feed; the maximum tolerable dietary concentrations proposed for animals are 2 mg/kg, and could be toxic if levels reach 5-15 mg Se/Kg (American National Academy 1983).

As it does in animals, Se functions in human body as an anti-oxidant and a component of another antioxidant (glutathione peroxidase). Deficiency of either substance impairs the human body's immune system and its ability to fight infections. Selenium was also reported to have a protective effect against certain chemically-induced diseases; while its deficiency could cause some cardiac problems and prostate cancer in humans (Challem, 1995).

However, the narrow range between beneficial and harmful levels of Se makes it necessary to determine these critical levels in the environment, including plant and soil. It is recommended that serious research programmes should be conducted in the Region to know how to manage this element in deficient areas and to control its effect when existing at toxic levels to animals or plants (Bashour, 2003).

4.3 Micronutrients in Human Food and in Animal Feeds

Tukan (2000) concluded from a study on "Availability of Micronutrients in Jordanian Diet" that the cereal group was the most important portion in the Jordanian diet, as well as in most other countries of the Region. Cereals provide about half of the energy, protein, B1, P, Mg, Zn, and Ca that are needed for human body; while vegetables provided more than half of Vitamin A and C.

It should be noted in this regard that some of the micro-nutrients are *not essential to plants, but are essential to animals*. Animal-source food supplies are, not only high-quality and readily digested protein and energy, but also a compact and efficient source of readily available micronutrients and vitamins. Those derived from animal products include: iron, zinc, and vitamin B12; in addition to other nutrients such as thiamin, calcium, vitamin B6, vitamin A, and riboflavin that are available from certain types of meat and/or dairy products.

For human nutrition, the micronutrients of major concern for growth and development and health of children are iron, iodine, zinc, calcium, and vitamins A and B12 and of late, Selenium. The main micronutrients offered in abundant and bio-available form by animal products are calcium and B12 from milk, and iron, zinc, and vitamin A from meat. The zinc content of 100 grams of beef, for example, is more than twice that of maize and beans, and it is up to 10 times as absorbable. Similarly, milk products are an important source of calcium; it is difficult for a child to even approach the average calcium requirements (estimated at 345 mg/d) on a cereal-based diet.

The beneficial effects of adequate supply of micro-nutrients on quality of plant products are highlighted below:

- Fe in green leaves is an important source of Fe-supply to humans;
- Mn contents if food and fodder are important quality criteria, as optimal level of Mn raises the contents of carotene and Vitamin C;
- Cu fertilization increases the Cu-content in plants and makes a better-quality fodder, particularly its taste;
- Zn fertilization would increase its level in plants and could reach some toxicity limits, which should be avoided;
- B is important to keep at sufficient level because if it is deficient, it will produce inferior fruit and vegetable products;
- Mo is critical to keep at sufficient level due to its role in Nitrate reduction metabolism, so increased Mo-supplies would raise protein content and quality of legumes, for example.

- A good example showing the *Influence Chain (soil-plant-man)* came from New Zealand; when certain soils were poor in available Mo(molybdenum), so naturally the vegetables grown on those soils contained too little Mo. Persons mainly subsisting on such Vegetables had an inadequate Mo intake. As this micro-element (in addition to Fluorine) is essential for strong teeth; the some tested school children teeth were less healthy and more susceptible to the incidence of caries (quoted by Finck, 1982).

5. CONCLUDING REMARKS

Below are some concluding remarks on the above subject:

- Call upon Member Countries of the Region to give due attention for conducting more research on role of micro-nutrients in plant, animal and human nutrition, especially elements such as Se that has not been studied yet.
- For FAO to assist Member Countries in establishing a Regional Network for Information on micronutrients in the Near Eastern countries for exchange of knowledge and experiences.
- Call upon private sector in the Region (mainly food and fertilizer industries) to *allocate adequate funds for studying micro-nutrient health or directly conduct such research through their Research and Development Departments.* Such findings should be shared through the Regional Network, with technical assistance from FAO.
- Call upon Member Countries to consider adopting *Balanced Fertilization Programmes* in drafting the nutrients recommendations to include both plants and animals, as a means for producing balanced healthy plant and animal food items.
- Encourage dialogue and joint research programmes among scientists and researchers in plant, animal and human nutrition for identifying those intricate relationships that would lead to having a safe human food chain.
- Call upon FAO to provide technical assistance to Member Countries to initiate studies and research programmes for the adoption of an Integrated Plant Nutrition System approach to reach sustainable and environmental-friendly plant nutrition programme.

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SELENIUM IN SOILS AND PLANTS: THE EFFECT ON ANIMAL AND HUMAN NUTRITION

ABSTRACT

Selenium (Se) is both toxic and beneficial to plants, animals and humans. It is widely distributed throughout the environment. Selenium may exist as selenide (Se^{2-}), elemental Se (Se^0), selenite (SeO_3^{2-}) and selenate (SeO_4^{2-}), each oxidation state exhibits different chemical behaviour. Therefore, it is imperative to know its concentration in the environment and to understand the processes controlling its distribution and availability. Animals require 0.05-0.1 mg Se/Kg in their diets to prevent Se deficiency, but suffer from Se toxicity when Se concentration in the diet exceeds 5-15 mg Se/Kg. Although its essentiality not proven for plants yet, however it is well documented that animals grazing on seleniferous plants suffer from Blind stagger and alkali diseases and Se deficiency causes Keshan disease, cardiac problems and prostate cancer in humans. The narrow ranges between beneficial and harmful levels of Se makes it necessary to determine Se levels in the environment (Plants & soil) in the Near East region. Since the 1950s, a large research effort was spent on Se in Europe, U.S. and other countries, but very minimal work has been done in this region. It is recommended that serious research program be conducted in the Near Eastern region to know how to manage this element in deficient areas and also in areas where it may exist at toxic levels to animals and plants.

1. INTRODUCTION

The uptake of selenium (Se) by plants from soils has been studied by many researchers since the discovery of Se dual nature that could be beneficial or toxic to plants, animals and humans. Se toxicity occurs in regions where Se is high in soils and subsequently in plants and Se deficiency is usually found in regions where the soil is low in Se. Therefore, the amount of Se in human diet and animal feed is largely determined by the amounts of available Se in the soil.

Selenium is intermediate between sulphur (S) and tellurium (Te) and its chemical properties are intermediate between those of S and Te. It is a metalloid, shares the characteristics of both metals and non-metals, and this gives it special importance in health, nutrition and industry (Duckart et al., 1992).

Its electrical conductivity is low in the dark and increases several hundred folds in light. It is a semiconductor with asymmetrical conductivity which allows it to conduct an electrical current more easily in one direction than in the other. These properties make it of exceptional value for industry.

Elemental selenium (Se^0) is highly insoluble and under oxidizing conditions it is converted to more soluble forms such as selenite (SeO_3^{-2}) and selenate (SeO_4^{-2}). The organic compounds of Se are of considerable interest and several of them play important roles in cell biochemistry and nutrition.

Se has 6 naturally occurring stable isotopes Se 74, 77, 78, 80 and 82, with composite atomic weight of 78.96 (McNeal and Balistrieri, 1989).

Studies showed that the availability of Se in soils is governed by parent material, environmental conditions and plant species.

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2. SELENIUM TOXICITY

Marco Polo in 1295 mentioned that hooves of his livestock became swollen and dropped off when the horses grazed on plants growing in certain areas of Western China. Father Pedro Simon in 1560 in Columbia described the loss of hair and nails in humans presumably suffering from chronic Se ingestion. Dr. Madison in 1857 in the U.S. reported that hair, mane, tail hair loss and sloughing of hooves occurred in horses grazing in certain areas that later shown to be high in Se. In addition to other similar reports of intoxications by Nebraska Research station and the Farmers of Wyoming who demonstrated that these abnormality syndromes were due to livestock consumption of Se-containing forages.

Attention was refocused on Se in the environment in the early 1980's, when subsurface agricultural drainage water was used for the creation and management of wet lands in Kesterson Reservoir at the Kesterson National Wildlife Refuge in California. Water in the reservoir is not used for domestic purposes or for irrigation but it is allowed to evaporate. Studies showed a bioaccumulation of Se in plants and animals at the reservoirs at levels that could adversely affect wildlife, cause mortality and impaired reproduction of aquatic birds.

Selenium toxicity in animals including livestock, poultry and swine occurs when they are fed on seleniferous forage or grains. Symptoms could be characterized by abnormal posture and movement, watering diarrhoea, laboured respiration, abnormal pain, prostration and death. Consumption of moderately seleniferous grains and forages for several weeks causes alkali disease syndrome that is characterized by hair loss, deformation and sloughing of the hooves. Blind staggers another disease that was described in sheep poisoning making the animal wandering in circles coupled with legs weakening, swallowing inability, blindness, abdominal pain, salivation, emaciation and death.

Rosenfeld and Beath (1964) described chronic Se poisoning of people living in the state of South Dakota in USA and Columbia in South America who consumed home-produced vegetables and other food. They reported loss of hair by man or animal birth of monstrous-looking babies, sterility of small animals and horses suffering from hoof damage.

3. SELENIUM DEFICIENCY

Keshan-Beck disease (enlarged joints) attacking children and teenagers which occurs in the mountains and hills of central China, was recognized to be associated with Se deficiency in 1849 (Levander, 1997). Symptoms of cardiac insufficiency with shortness of breath and chest tightness were then related to Keshan disease. Table 1 lists some of the conditions which have been recognized as being related to Se deficiency. For many years, several of these symptoms responded also to vitamin E treatment, but not as effectively as to selenium. Although Se deficiency is a major factor in all of them, it is often not the only cause.

Table 1. Selenium-responsive conditions in farm animals*

Condition	Species	Tissue affected
White muscle disease	Cattle, sheep, poultry, pig, etc.	Skeletal and heart muscle
Exudative diathesis	Poultry	Capillary walls
Panceatic degeneration	Poultry	Pancreas
Liver necrosis	Pig	Liver
Ill-thrift	Cattle, poultry, sheep	Muscle mass

* After Oldfied, J.E. (1990) *Selenium: Its Uses in Agriculture, Nutrition and Health and the Environment*, Selenium-Tellurium Development Association, Grimbergen.

Although selenium in the past was officially listed as a carcinogen, its possible effectiveness in cancer therapy was considered about 80 years ago. Much research has been conducted on the possibly protective properties of Se against several types of cancer. Many of the studies showed that a significant relation exists between Se levels in blood and cancer incidence, especially in the case of leukaemia. Other researchers reported negative correlations between Se & some forms of cancer in humans (Reilly C.1996).

The role of Se in the immune systems of animals has become increasingly apparent. Se deficiency appears to affect both hormonal and cellular immune responses. The findings showed that different animals, such as sheep, mice, and humans do not all respond in the same way to Se deficiency and excess. Therefore, treatment with high-dose selenium supplementation should be done only after carefully taking the possible consequences into consideration.

4. SELENIUM IN SOILS

Selenium occurs in all soils, with concentrations ranging from <0.1-1000 µg/g, as reported in Table 2.

Table 2. Selenium levels in soils from different countries.

Country	Se values (µg/g)	Identification
USA	<0.1-4.4	Normal values
	1-80	In seleniferous soils
New Zealand	<0.3	Very low
	0.3-0.5	Low
	0.5-0.9	Average
	0.9-1.5	High
	>1.5	Very high
China	0.37-0.48	Low
	0.73-5.66	Medium
	7.04-12.08	High
Ireland	34-220	Seleniferous soils

Ref. Selenium in Food and health by C. Reilly, 1996 Chapman and Hall.

The level of Se in a soil is determined mainly by geochemical factors, especially the nature of the parent rock. Whereas highly siliceous rocks, such as granite, and shale may contain high levels of Se. Volcanic activity, combustion of fossil fuels, weathering of rocks and soils, soil leaching, groundwater transport, plant and animal uptake and release, adsorption and desorption, chemical and biological redox reactions and mineral formation are the major processes behind Se distribution throughout the environment (McNeal and Balistrieri, 1989). Table 3, shows the levels of Se in various rocks and minerals.

Table 3. Se levels in Rocks and Minerals

Rock/Mineral	Se level (µg/g)
Shales	0.6-500
Limestones/sandstones	<0.1
Volcanic Rocks in California	0.1-0.6
Volcanic Rocks in Hawaii	<1-2
Magmatic Rocks	<0.05
Phosphate Rocks, California	1-178

Ref. Selenium in Food and Health by C. Riely 1996 Chapman Hall.

It was reported by Moxon and Olson in 1950 that soils which are derived from sedimentary rocks

in arid and semi arid regions have generally high Se content. However, the results of more recent studies on arid soils derived from sandstone in Saudi Arabia (Al-Saleh et al., 1999) and semi arid soils derived from chalk in Lebanon (Lteif A, 2001) indicate that Se levels were low in both locations. Lteif (2001) also found that topsoils (depth = 0-15 cm) of Lebanese calcareous clay soils have higher Se content than subsoils (depth = 15-30 cm) and that Se content decreases with depth. This fact could be explained by the chemical precipitation and micronutrient recycling in soils. Havline et al. (2000) outlined forms of soil Se as follows:
Selenides (Se^{-2}) are largely insoluble and contribute little to Se uptake, elemental (Se^0) present in limited amounts in some soils may be oxidized, mostly to selenates (SeO_4^{2-}) in neutral and basic soils and to selenites (SeO_3^{2-}) in acidic soils. Plants absorb selenites, but to a lesser extent than selenate; selenates (SeO_4^{2-}) frequently associated with sulfate (SeO_4^{2-}) in arid regions. Selenates are highly soluble and readily available to plants, thus largely responsible for toxic accumulations in plants grown in high-pH soils; and organic- Se (Se-complex) can be an important fraction of Se in organic soils and often present in humus.

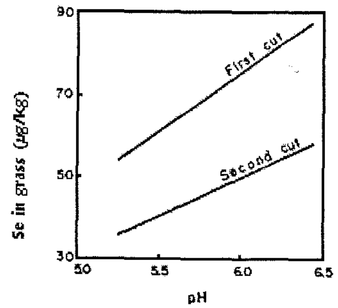
5. SELENIUM IN WATER

Selenium concentrations in water is usually very low, a few micrograms per liter. The World Health Organization (WHO) sets a maximum standard of 0.01 µg/L for Se in drinking water. However, most of the times the concentrations of Se in water flowing in seleniferous regions is higher than the WHO standard.

6. SELENIUM IN PLANTS

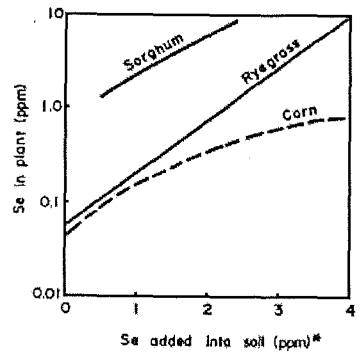
Although Se in plants has been investigated in many studies, its physiological role is not fully known and it is still considered as an unessential element for plant growth. The Se-accumulator plants synthesize Se-methyl-cysteine, whereas no accumulator species produce Se-methyl-methionine. However, the physiological significance of this difference is not yet understood (Kabata-Pendias 2000).
The availability of soil Se is also controlled by several soil factors, among which pH is believed to be the most pronounced (Fig. 1). Se is readily absorbed by plants when present in soil in soluble form (Fig. 2). The volatilization rate of Se by plants differs for species within the highest in the gummy exudates of Astralagus gummifer of *Tragacanth* (70 µg Se per m^2 leaf area per day) and the lowest for fescue, the cold, wet season forage grass (3 µg Se per m^2 leaf area per day) (Duckart, E.C. et al., 1992).

Fig. 1. Se content of ryegrass as a function of the soil pH.



Ref. Moré, E. and Coppnet, M. Teneurs en selenium des plantes fourragères influence de la fertilisation et des apports de sélénite, Ann. Agron.31,297.1980. In Kabata-Pendias 2000.

Fig. 2. Influence of Se added as Na_2SeO_3 into the soil on Se content of plants sorghum.



Ref. Moré, E. and Coppnet, M. Teneurs en selenium des plantes fourragères influence de la fertilisation et des apports de sélénite, Ann. Agron.31,297.1980. In Kabata-Pendias 2000.

Se seems to be easily absorbed from the atmosphere since its content in mosses varies from 500-2900 µg/kg in Scandinavian countries.
Se concentrations ranged from 782 to 2721 µg/kg in alfalfa and 530 to 1954 µg/kg in corn plants in Lebanon (Lteif, A. 2001). Tables 4 and 5 show the Se contents in forage plants and cereal grains in different countries and Table 6 shows Se levels in soils and plants in Near Eastern countries (FAO, Soils Bulletin #65, 1992).

Table 4. Selenium levels in forage plants from different countries.

Country	Grasses		Clover or Alfalfa		Hay or fodders	
	(µg/kg)	Mean	µg/kg	Mean	µg/kg	Mean
Canada	5-23	13	5-31	15	-	-
Germany	30-210	110	50-130	30	-	-
France	19-134	47	36-39	38	29-35	31
India	200-450	352	440-870	672	200-870	-
Japan	5-174	43	6-287	33	4-28	13
U.S.A.	10-40	32	30-880	320	28-360	98

Table 5. Selenium levels in various plant tissues in different countries in µg/kg.

Plant	Country	Range	Mean
Wheat grain	Australia	1-117	23
	Denmark	4-87	21
	Egypt	140-430	340
	Finland	100-170	-
	France	30-53	36
	Germany	190-200	200
	Norway	1-169	33
	U.S.A.	280-690	490
	Yugoslavia	5-23	
Barley grains	Canada	9-38	21
	Denmark	2-110	18
	Finland	<10-50	-
	France	27-42	33
	U.S.A.	200-1800	450
Oats grains	Canada	4-43	28
	Denmark	3-54	16
	France	20-44	35
	Germany	70-140	110
	Japan	8-17	-
	U.S.A.	150-1000	480
Corn seeds	U.S.A.	10-2030	87
Cabbage leaves	U.S.A.	-	150
Lettuce leaves	U.S.A.	-	57
Carrots roots	U.S.A.	-	64
Onion bulbs	U.S.A.	-	42
Potato tubes	U.S.A.	-	11
Tomato fruits	U.S.A.	-	36
Apple fruits	U.S.A.	-	2.6
Orange fruits	U.S.A.	-	7.7
Potato tube	Czech Republic	-	83
Apple fruits	Czech Republic	-	8

The data in Table 5 taken from Kabata-Pendias, 2001.

Table 6. Selenium levels in soils and plants in Near Eastern countries in µg/kg.

Description	Country	Range
Soil	Egypt	32-580
	Iraq	22-3700
	Lebanon	22-280
		7-162(1)
	Syria	20-900
	Turkey	25-300
Maize	Egypt	4-350
	Iraq	20-1000
	Lebanon	15-70
	Lebanon (mature 3rd & 4th leaves)	530-1580(1)
	Lebanon (mature whole plant)	621-1954(1)
	Syria	6-300
	Turkey	3-120
Wheat	Egypt	5-180
	Iraq	20-1800
	Syria	14-500
	Turkey	5-500
Alfalfa	Lebanon	782-2721(1)

The data in Table 6 is taken from FAO Soils Bulletin #65 (Note that Maize sampling at 5-6 leaf stage & Wheat sampling at Mid-tillering stage) & (1) from Lteif A., 2001.

It is clear that the mean Se content of food plants rarely exceeds 100 µg/kg (ppb). The safe level of Se varies widely with the source, and disorders in livestock may be expected when Se concentrations in forage plants are about or below 20 µg/kg (Dry Weight). Other values, such as lower toxic level of 3000 µg Se/kg and minimum requirement of 100 µg Se/kg are also proposed for grass land.
In general, the trend in variation of Se concentration in plants indicated higher Se levels in plants from arid zones than those from humic regions.
Some plants such as *Brassica* which have the ability to absorb accumulate and volatilize Se, have been studied as a remedy for removal of Se from contaminated sites. In areas of low Se, applications of sodium selenite to the soil or as a foliar fertilizer are proposed for the correction of Se deficiencies. This practice should be carefully controlled and applied when needed only.

7. SELENIUM AS A FERTILIZER

The development of a safe and effective Se fertilizer must consider the chemical form, its solubility, soil pH, redox potential and the rate, amount and method of application of Se. The application of fertilizers containing phosphate, sulfate or nitrogen can affect Se levels in the plant (Milchunas et al., 1983). These materials may contain small amounts of Se or they may stimulate root growth and subsequent uptake of soil Se. Fertilizers made from rock phosphates may contain as much as 200 mg Se/kg (Senesi et al., 1979).
Foliar application of selenite to plants is an effective method to increase Se in forage plants. Gissel-Nielsen in 1981 sprayed 3-5 g Se/ha as selenite on barley plants during tillering stage (Feekes growth stage 4-6) and demonstrated that this was enough to get Se into the grain. Se applied as Na_2SeO_3 to alfalfa or ryegrass seed at a rate of 50 g Se/ha maintained plant tissue-Se level at >0.1 mg/kg for 3 cuttings (Gupta et al., 1984).
Application of 10 g Se/ha as selenite to pastures or applying Se with a carrier fertilizer have been suggested as efficient methods for raising Se levels in plant tissue and seeds. Fertilization with

selenites is preferred because they are slower acting and thus less likely to produce excessive levels of Se in plants than the rapidly available selenates, which are effective if rapid Se uptake is desired. In New Zealand, a country which suffers from low level of Se in grass land, 1% Se granulate is mixed with bulk blended fertilizers, whereas in Finland a 1% Se solution is sprayed into the granulation drum of compound fertilizers at an equivalent rate of 6-16 g Se/ha. It should be mentioned that a special attention be given to Se fertilization in order not to raise Se concentration in plant tissue to toxic levels for animal nutrition. Therefore, top dressing to herbal growing plants must be avoided.

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A Review of Animal Feeding Issues in Relation to The Provision of Animal Source Foods for Humans

SUMMARY

The paper discusses first, the central role of animal production in the food chain and the intimate relationships between soils, crops, livestock nutrition and human nutrition and health. The value of animal source foods in the human diet is highlighted. Animal products being the best sources of high biological value proteins, essential micronutrients such as trace elements and vitamins. Implications of low intakes of animal sources foods on human health and well being, particularly in vulnerable groups, children and women, are presented with examples taken from observational studies in various geographical zones. Options for increasing the availability for human consumption of meat and other animal products are also suggested in the paper. Trends in global production and consumption of animal source foods are described, based on FAO's statistical database. The paper attempts to explain the reasons for differences between groups of countries and regions, with particular emphasis on Africa and the Near East. Examples of animal nutrition effects on the provision of animal source foods for humans are also presented, ranging from general effects on quantity to specific effects of the animal's diet and feeding regime on the composition of animal products. Fat, cholesterol and micronutrient levels in animal source foods, particularly meat, can be significantly affected by the feeding system of animals at a given stage of maturity and for a given specie and breed type. The safety on animal source foods has become a matter of great public concern in recent years; the paper describes briefly the issue in relation to the recent BSE crisis and other feed-born problems. FAO's role and activities in the area of feed and food safety assurance are also highlighted.

1. INTRODUCTION

Agriculture, Animal Production, Human Nutrition and Health relationships

Most International Organizations such as WHO and FAO adopt a broad view of defining human health as a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity. From this definition, it can be easily established that good health is not possible without adequate food. While traditionally assigned the role of production and distribution of food, the ultimate overall goal of agriculture is in fact the maintenance of adequate human nutrition and human health and well-being. By providing the essential proteins and other nutrients for humans , animal products and thus, animal production plays a central role in the food chain and in the intimate relationship between agriculture in general, and crop production on one hand, and human nutrition and health. On the other hand, soils are the natural base for cultivated crops and spontaneous vegetation and livestock and poultry are essentially herbivores. Animal raising is therefore merely a process of conversion of soil nutrients into animal source foods for humans.

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2. THE VALUE OF ANIMAL SOURCE FOODS FOR HUMANS: NUTRITIONAL AND HEALTH CONSIDERATIONS

Animal source foods are primarily known to be the best sources of protein for humans. Animal protein is highly digestible (90 to 100%), while digestibility of plant protein is much lower and more variable (50 to 70%). Animal proteins have also a much higher biological value, with consistently elevated amounts of essential amino acids (Lysine, Methionine, Threonine...). Animal source foods both meat, milk and eggs are also compact and efficient sources of essential micronutrients with high bioavailability in the human body. Calcium, Iron, Zinc and Vitamins A and B_{12} are the most abundant micronutrients in these animal products. Of special importance, Vitamin B_{12}, for which animal products are almost the exclusive sources. Fish are also equally good sources of protein, Iodine and Vitamins, including Vitamins A and D in fatty fish. Milk is widely known to be the most complete of all foods, containing almost all the nutritionally important constituents, it is obviously the best source of nutrients for growth and for acquiring and maintaining the efficiency of the immune system. Reports linking the consumption of animal products and animal health and well-being are widely available in the literature. In recent years, there has been an increasing awareness of 'hidden' malnutrition or multiple micronutrient deficiencies due to inadequate intake of animal source foods. Adverse effects on growth and cognitive development of young children and women of reproductive age has been recognized and they are receiving an increasing attention in the human nutrition community (Scrimshaw, 1994; Neumann, 2000).

Effects range from stunting due to inadequate energy intake and deficiencies of Zinc, Calcium, and Iodine, low birth weight associated with deficient maternal intakes of Iron, Zinc, Iodine and Vitamin B_{12}, impaired cognitive function and learning ability which can be caused by a micronutrients deficiencies involving Iron, Iodine, Zinc and B_{12}. In addition to the well known nutritional anaemia's caused notably by lack of Iron, B_{12}, folate, Vitamin A or Pyridoxine, impaired resistance to infection through impairment of the cell mediated immune system can also be caused by deficiencies of several micronutrients such as Zinc, Iron and Vitamin A, which are normally present at high concentrations in animal source foods.

These micronutrients deficiencies are widespread, affecting large numbers of the population globally, particularly in many developing countries. For example, estimates of up to 40 % of women and 70% of infants suffer from Iron deficiency, mainly in Africa and Asia (Neumann, 2000). For these reasons, livestock products are recognized to have a central role in the improvement of human health through alleviation of these nutrient deficiencies. Many integrated research/development studies have aimed to establish and show the link between livestock development and human nutrition. Observational studies conducted in rural areas of Kenya, Mexico and Egypt under the USAID funded Collaborative Research Support Program (CRSP) were summarized by Calloway et al. (1992). They have documented that animal source foods, even in modest amounts, with their high energy density and content of micronutrients, particularly of heme Iron, Zinc, Vitamin B_{12} and good quality proteins have contributed positively to normal growth, physical activity and cognitive function of children. The predominance of maize and beans (60-70% of total energy intake) in the typical Mexican and Kenyan diets and the very low intakes of milk and meat products have caused serious difficulties in terms of health, growth and development of infants and children in these areas. A similar situation is observed in much of Asia, where rice, the staple food, is known to have the lowest average protein content of all cereal grains. In the prevailing polished form, it is considered the least nutritious of all the traditional staples.

In other studies conducted in Ethiopia (Haider et al., 2000), the introduction of crossbred cows with a higher milk production potential in rural communities of Holetta Wareda region, resulted

in increased food production and income and a higher consumption of dairy and meat products with a subsequent and measurable improvement in the nutrition and health status of the rural farmers.

From these and other studies, it becomes clear, the critical role of animal production, especially small livestock in sustainable and affordable improvement of diet quality and health of families of the less developed and poor countries.

In practice, various options exist for increasing the availability for human consumption of meat and other animal products in a given country. They essentially depend upon the availability of feed resources, the presence of adequate infrastructure for slaughter, distribution and marketing, the control of endemic diseases of livestock, and other climatic and socio-economic factors. The choice of animal species (cattle, small ruminants, poultry, rabbits, fish....) and production systems (industrial, backyard, or combinations of the two) also depends on these major factors.

3. TRENDS IN GLOBAL PRODUCTION AND HUMAN CONSUMPTION OF FOODS FROM ANIMAL PRODUCTS

In the last decades, the increasing demand for animal products resulted in a subsequent growth of the animal feed sector and related industries. Nowadays, a considerable part of crop land goes to make animal feed. Global estimates of as much as 60% of corn, 90% of Soya bean and other oil seeds and 30% of small cereal grain are used in the feed industry to make compound animal feeds. Although, the supply of animal source foods has improved in many parts of the world, the global potential demand for animal products is still quite high. It is an established fact that any growth in spendable income will result in a much higher increase in consumption of animal protein. The first reaction to a better purchasing power is usually a higher proportion of animal products in the diet, particularly meat. It is therefore predicted that there will be a continuing demand for animal protein foods for human consumption in most developing countries: Asia and Africa, in particular.

According to Delgado et al., (1999), global meat production will rise from an estimated 233 million tonnes in 2000 to nearly 300 million tonnes in 2020, the corresponding figures for milk are respectively 568 and 700 million tonnes, over the same period. Egg production will also increase by about 30%. It is worth noting that most of the increase in meat production in the last few decades has been met by the wide growth of the intensive poultry production sector. The production of poultry meat has increased from nearly 9 million tonnes in 1960, to 15 in 1970, 26 in 1980, 41 in 1990 and 68 million tonnes in 2000.

The following selected figures from FAO's data base compiled by Speedy (2002) show trends during the last 4 decades in availability for human consumption of meat, milk and eggs in developed and developing countries. Significant differences between countries exist, however. In particular, the spectacular growth in meat production that has been taking place in some countries, including some of the most populous ones such as China and Brazil.

Figure 1. Meat Production

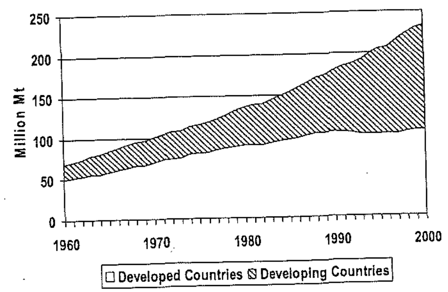


Figure 2. Milk Production

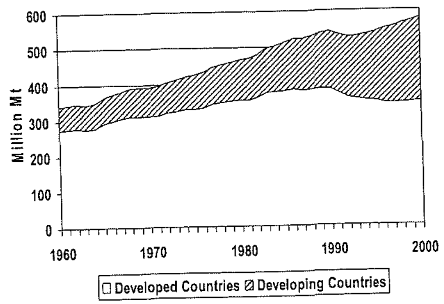
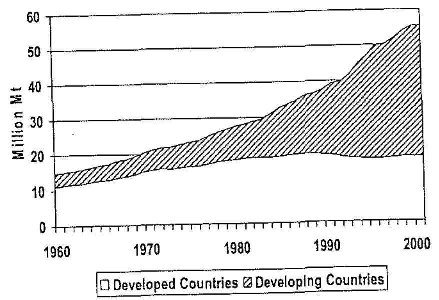


Figure 3. Egg Production



On the other hand, consumption of these animal products in various countries is presented in *Table1* and shows an extremely uneven pattern. In descending order of meat consumption per capita per year, the values exceed 120 Kg in Uruguay and USA for example, and can be as low as 3 to 5 Kg in some countries of Africa and South Asia (Burundi, Sierra Leone, Sri Lanka, Bangladesh,..), while the world's average is estimated at 38 Kg.

Although, the overall global supply of animal products has increased steadily, the benefit to the majority of the world's population has been so far very limited. When the size of population in the various countries is taken into account, the data suggest that approximately one third of the World's population consumes less than 10 Kg of meat per capita per year (Speedy, 2002). Meat consumption has been even falling in the last few years, in many African countries.

As stated above, the main determinant of per capita meat consumption appears to be the wealth or the individual's income level. This is shown in the good relationship (*Figure 4*) between meat consumption and the Gross Domestic Product (GDP). Except for some countries with particular eating habits (Latin America) and those being traditionally herding countries (Somalia, Ethiopia), the poor countries of Africa and Asia have the lowest consumption figures and the rich developed countries have the highest figures.

This also explains why, except for some Gulf countries (UAE, Kuwait, Saudi Arabia,..), the consumption of meat, eggs and fish and to some extent, the consumption of milk products in the Near East region is very modest and falls well below the world's average. For this region, it appears that there is a large room for improvement of the nutritional status of the population through an increased consumption of animal source proteins. In addition to improvement of livestock productivity which generally leads to lower prices of animal products, a better exploitation of the available fishery resources seems to be necessary to achieve this goal.

Figure 4. Per capita meat consumption in relation to GDP

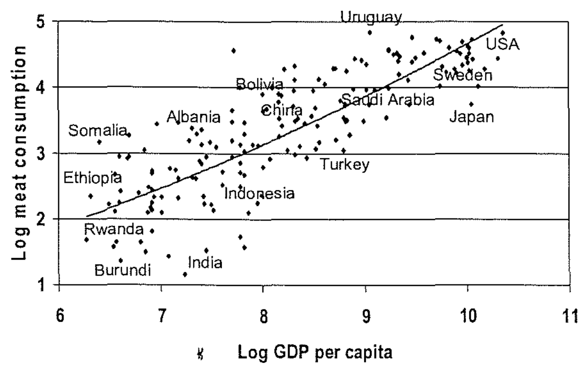


Table 1. Consumption of Meat, Milk, Eggs and Fish by Country (kg/capita/yr)

Country	Meat	Milk	Eggs	Fish	Country	Meat	Milk	Eggs	Fish
Uruguay	126.5	131.6	9.3	8.6	Belarus	62.2	130.2	13.2	1.6
USA	124	117.3	14.5	22.4	Bulgaria	61.5	125.2	11.2	4.4
Cyprus	117.6	148.9	11.2	23.5	Chile	61	65	4.6	18
Spain	113.1	108.1	13.9	42.4	Estonia	57.6	137.7	11.4	23
Denmark	112.4	37.1	14.7	27	Norway	55.8	91.4	10.2	61.9
New Zealand	109.9	63.2	11.9	24.7	Brunei Darussalam	55.6	53.7	14.1	21.9
Australia	108.9	103.6	6.3	20	Dominica	55.4	119.2	2.7	36.7
Canada	101.1	53.7	10.8	24.4	Saint Vincent/Grenadines	54.7	56.8	5.2	19.4
France	99.9	61.1	16	32.1	Jamaica	54.3	27.3	9.9	17.8
Ireland	99.4	174.8	6.9	17.2	Malaysia	54	17.3	13.7	54.2
Argentina	97.7	107.5	6	9.9	Panama	53.4	46.6	4.5	14.3
Slovenia	96.2	88.3	10.4	7.3	Mexico	52.9	78.5	14.4	11.8
Mongolia	95.9	124.7	0.1	0.1	Saudi Arabia	52.6	50.1	4.8	8
Bahamas	95.1	42.9	4.5	21.8	Romania	52.3	176.8	9.9	2.4
Portugal	92.8	83.7	9.3	58.7	Lithuania	52.2	61.1	9.8	18.3
Barbados	92.7	63	3.4	41	Suriname	49.8	30.3	11.1	23
Italy	91.3	45.6	12.9	25.3	Bolivia	49.4	25.6	6.9	2.4
Austria	90.9	83.3	13	16.8	China, Mainland	48.1	6.4	15.6	35.7
French Polynesia	90.6	50.1	6.5	67.5	Gabon	44.9	18.9	1.4	52.7
Netherlands Antilles	87.6	49.5	2.7	23.1	Grenada	43.8	65.9	7.7	27.6
Netherlands	85.9	140	16.1	18.1	Fiji Islands	42.9	44.5	4.2	32.5
Greece	85.5	67.1	10.3	29.6	Japan	42.4	43.5	19.2	71.9
Germany	85.3	66.2	12.2	17	Venezuela, Boliv Rep of	42.4	42.3	5.6	22.1
Bermuda	84.6	25	8.7	45.7	Korea, Republic of	42.3	16.8	9.2	50.3
Hungary	84.3	78.6	15.7	6.7	Costa Rica	41.4	143.5	5.4	8.4
Belgium-Luxembourg	84	55	14.4	23.1	Russian Federation	41	124.9	12.3	25.4
Yugoslavia, Fed Rep of	82.7	146.9	6.9	4	Dominican Republic	40	41	5.1	12.6
Antigua and Barbuda	82.5	116.4	2	38.6	Kazakhstan	39.5	174.2	4.7	5.4
Czech Republic	81.3	42.3	16.4	12.9	Kyrgyzstan	38.4	173.9	2.7	0.7
Malta	80.4	96.9	16.9	40.9	Belize	38	85.7	6.3	8.5
China, Taiwan Prov of	79.7	31.1	14.6	43	Ecuador	35.3	90.8	3.2	7.6
Iceland	79.3	120.6	5.7	94	Mauritius	34.4	88.8	3.2	22.5
Slovakia	78.1	45.9	13.2	6.4	Colombia	34.4	103	7.1	6.4
United Kingdom	76.3	121.1	9.2	24.5	Jordan	34	39	7.5	3.5
Saint Lucia	75.6	54.8	3.2	22.7	Swaziland	34	62	2.8	0.2
United Arab Emirates	74.6	120.9	9.9	27.1	South Africa	33.2	43.2	6.3	7.4
Saint Kitts and Nevis	73.4	71.4	5.3	37.6	Trinidad and Tobago	32.7	45.5	7.6	14.2
Brazil	73	118.7	6.7	8.6	Latvia	32.7	127.4	9.4	12.5
Sweden	72.4	73.2	11.6	30.6	Libyan Arab Jamahiriya	32.7	52.9	10	6.1
Paraguay	72.4	83.9	7.8	11.1	Ukraine	32.4	150.4	9.6	9.6
Switzerland	72.3	92.5	10.5	21.5	Guyana	32.1	57.7	8	73
Kuwait	70.3	45.8	11.6	11.2	Vanuatu	32	17.4	1.6	24.8
Poland	70.2	68.6	10.5	15.6	Lebanon	31.5	31.8	7.3	6.9
China, Macao SAR	68.5	27.2	10	49	Macedonia,The Fmr Yug Rp	31.2	16	9.9	5.4
Israel	68.3	59.2	11.9	26.4	Botswana	30.4	88.1	1.7	8.9
Finland	67.3	131.3	9.3	43.9	Croatia	30.4	108.6	9.8	4.9
New Caledonia	66.5	85.5	6.9	25.2	Albania	29.3	242.2	5.7	2

Consumption of Meat, Milk, Eggs and Fish by Country (kg/capita/yr) (continued)

Country	Meat	Milk	Eggs	Fish	Country	Meat	Milk	Eggs	Fish
Turkmenistan	28.5	122.4	3.2	3.9	Cambodia	14.4	2.3	1.1	12.5
Cuba	26.9	28.9	5.9	16.4	Congo, Republic of	13.9	9.3	0.5	30.6
Uzbekistan	26.8	131.9	2.7	0.9	Benin	13.8	5.1	2	12.9
Seychelles	26.6	33.5	5.8	62.3	Kenya	13.7	76.7	1.3	8.5
Kiribati	26.3	18.4	1.4	76.3	Pakistan	12.4	87.2	2	3.5
Philippines	25.8	4.4	7.6	33.2	Zimbabwe	12.1	14.1	1.2	3.2
Thailand	24.6	12.2	9.6	40	Niger	12	10.2	0.6	1.4
Georgia	24.5	116.1	6.7	2.3	Burkina Faso	11.5	18	1	2.1
Cape Verde	24.3	76.9	4.2	24.4	Yemen	11.2	4.5	2	6.6
Tunisia	23.9	73.2	7.3	9.2	Zambia	11	5	3.9	13.9
Viet Nam	23.8	0.9	2	22.8	Togo	10.5	3.2	1.1	18.2
Somalia	23.7	187.4	0.3	1.7	Ethiopia	10.5	14.6	1.1	0.4
Papua New Guinea	22.9	3.7	0.7	16.2	Uganda	10.3	21.5	0.7	17.2
Armenia	22.9	45.8	3.3	1.8	Nepal	10.3	30.4	1	2
Central African Republic	22.8	16.5	0.3	7.1	Haiti	10.2	13	0.4	3.3
Egypt	22.6	13.6	2.1	14.1	Tanzania, United Rep of	9.5	18.2	1.5	17.6
Peru	22.3	44	4.8	27.1	Liberia	9.5	2	1.7	6
Mauritania	22.1	121.4	1.5	16.1	Indonesia	9.4	3.2	2	22
Iran, Islamic Rep of	21.6	24.7	6.5	6.5	Côte d'Ivoire	9.3	10.2	0.9	10.8
Sudan	21.1	117.6	1.2	3	Ghana	9.2	3.1	0.8	26.2
Turkey	21	93.5	8.6	7.7	Eritrea	9.2	16.4	0.4	0.3
Guatemala	21	28.8	9.1	2	Tajikistan	8.8	46.4	0.1	0.1
Syrian Arab Republic	20.8	59.6	6.8	1.4	Myanmar	8.6	7.9	1.4	18.9
Namibia	19.8	40.8	0.9	12.5	Maldives	8.5	46.6	1.1	154
Madagascar	19.1	33.1	0.9	9.5	Korea, Dem People's Rep	8.5	3.7	4	19.7
Bosnia and Herzegovina	19.1	116.8	4.6	2.1	Comoros	8.2	8.3	1	19.1
Moldova, Republic of	18.9	116	3.2	1.2	Solomon Islands	8.1	2.7	0.9	32.2
Afghanistan	18.9	61.8	0.7		Sao Tome and Principe	8.1	2	1.9	22.4
Algeria	18.7	74.4	3.5	3.5	Nigeria	8.1	5.8	3.5	6.7
Mali	18.6	42.6	0.7	18	Gambia	6.1	15.8	0.7	24.3
Morocco	18.5	10.6	5.2	7.3	Iraq	5.7	10.2	0.4	2.7
Senegal	17.8	13.2	2.8	43.7	Sierra Leone	5.4	4.9	1.4	18
Honduras	17.3	104.7	6.8	3.8	Congo, Dem Republic of	5.2	0.6	0.1	9.1
Azerbaijan, Republic of	17.2	113.6	4.2	1.9	Mozambique	5.2	3.9	0.7	2.7
El Salvador	16.4	71.9	6.9	3.2	Sri Lanka	4.8	35.9	2.4	22
Djibouti	15.9	53.5	0.7	3.5	Rwanda	4.8	13.1	0.3	0.9
Laos	15.6	2.2	1.4	16.3	India	4.6	47.5	1.5	7.1
Chad	15.4	25.7	0.5	12.6	Malawi	4.5	3.7	1.7	10.3
Guinea-Bissau	15.4	14.8	0.5	3.1	Guinea	4.2	9.4	0.9	15.2
Cameroon	15.1	14.2	0.7	10.5	Burundi	3.9	4.5	0.4	6.4
Lesotho	14.9	12.8	0.6	0	Bangladesh	3.2	12.8	1.1	17.5
Angola	14.8	13.8	0.3	6.7					
Nicaragua	14.5	29.6	6	1.7	**World**	**37.9**	**46.4**	**8**	**20.1**

4. ANIMAL NUTRITION EFFECTS ON THE PROVISION OF ANIMAL SOURCE FOODS FOR HUMANS

Being the major factor in livestock and poultry production, the feeding component, both in quantitative and qualitative terms, have a great impact on the yield (quantity), composition, safety, and the overall provision of human foods which are normally derived from animal products.

4.1 Effects on quantity

Nutrition is most often, the limiting factor of livestock productivity (milk yield, body weight gain, carcass weight and yield..). Adequate energy and protein intakes, sufficient supplementation with micro-nutrients (minerals, and vitamins) and adequate drinking water are all necessary for achieving a balanced animal diet to meet the requirements to the levels set by performance objectives and by the genetic potential of the breeds.

Breed differences exist in terms of their needs for specific nutrients, and animal production systems should be designed so that animal genetic resources are adapted to the local environment, particularly to the level of nutrition that can be supplied by the available feed resources.

Several examples of local development projects can be found in the literature, in which improvements of livestock nutrition and feeding practices (supplementary feeding, fodder banks, correction of nutrients deficiencies and upgrading of poor quality feeds) has resulted in significant increase in productivity and ultimately, a higher consumption of animal sources foods by the local communities. As an example, reports from Ethiopia by Haider et al. (2000), showed that considerable increase in food production and income was brought about by the introduction of crossbred cows and improvement of their nutritional status through forage cultivation, fodder conservation and other feeding practices. A positive impact on the nutrition and health status was demonstrated, particularly in the more vulnerable members of society, children and women. Similar findings were reported in development studies in the mountain areas of the Hindu Kush Himalaya in India (Tulachan et al., 2000)

4.2 Effects on Composition

Composition of animal source foods can be influenced by the ration fed to animals, the feeding regime and other dietary manipulations

Except for lactose (a carbohydrate) in milk, other animal source foods (meat, eggs) contain essentially fat, protein, minerals, vitamins and water in various proportions. While body composition of livestock and poultry, and therefore the composition of carcass at a given age and for a given breed remains relatively constant across various feeding regimes, notable modifications can be brought about by the overall state of nutrition of the animals and by dietary manipulations:

- In ruminants, the forage/concentrate ratio has an impact on the energy density of the ration which will affect the rate of fat deposition in the carcass, and fat and cholesterol levels in meat. Animals fed a high forage diet will have an overall lower carcass weight and leaner meat for a given state of maturity of the animal (body weight at slaughter/adult body weight) and for a given breed. Extensive and semi-intensive feeding systems primarily based on pasture grazing and relatively low intakes of grain and other concentrates, will result in lighter carcasses, lower dressing percentages, but generally lower fat and cholesterol levels in the carcass. On the opposite, intensive feeding systems and feedlot-type of finishing diets with high levels of grain, will result in faster weight gain, heavier carcass, higher yield of meat, but also higher fat and cholesterol contents. Ideally, feeding systems should be designed to meet the consumer preferences in terms of meat composition. Human health considerations with regard to excessive cholesterol and fat levels should also be taken into account. However other economic factors, related to the cost of feed per unit of body weight gain, have in practice, the most critical impact on the choice of feeding system and consequently on the overall meat composition. Due to their unique digestive system, in which the remain microbes act as a buffer, ruminant animals have a relatively constant composition of their body fat or adipose tissue. Being highly saturated due to intensive hydrogenation by the microbes, fatty acids composition of milk and meat fats from ruminants is usually constant under variable feeding regimes and diet compositions. Differences in fat content and fat composition between red meat and white meat (from monogastric animals and fish) are well established and used for making recommendations for healthier diets for humans. Differences in fat and cholesterol composition between meat from cattle and that from sheep and goats are also suggested and being argued among animal and human nutrition specialists
  Lactose content of milk is also usually constant and is not much affected by the animal diet, as lactose is the first compound to be formed in the mammary gland during milk secretion, it is more closely linked to total milk yield . It should be noted however, that generally speaking, species differences are quite high, and much more important than differences due to the animal diet, particularly for milk nutrient composition (fat and protein contents).
- The intake of micro-nutrients by livestock and poultry is also reflected to some extent in the content of these nutrients in animal products. This is usually the case with Calcium, Phosphorus and several trace elements. Thus, adequate levels of these in the animal diet is not only necessary for achieving adequate production performances, but also for optimizing the nutritional value of animal source foods for humans.

4.3 Effects on safety

Feed ingredients used in the animal feed industry can be of various natures and origins (plant, animal). In addition, several feed additives such as antibiotics, hormones, and growth promoters are commonly employed in order to protect livestock and poultry form diseases and to enhance their performance. Contaminations with various substances may also occur at harvest, and during processing, handling and storage of feed ingredients before their final destination into animal diets.

In recent years and in almost all countries, public concerns about the safety of foods of animal origin has increased due to problems that have arisen with bovine spongiform encephalopathy (BSE), dioxin contaminations of poultry feeds, outbreaks of food-borne bacterial infections, safety risks due to excessive mycotoxins in feeds as well as growing concerns about veterinary drug residues and subsequent implications for microbial resistance to antibiotics.

Most of these problems are in fact, animal nutrition related, and they have drawn attention to feeding practices that are used in the livestock and poultry sectors.

About 600 million tonnes of animal feed are being produced annually in the feed industry, with 4000 mills worldwide producing over 80% of the feed consumed by livestock and poultry. About 90% of these feeds are produced in 50 countries including the USA, Canada, China, Brazil. Mexico, Japan and most of the EU countries. The annual per capita animal feed use is estimated to be 98 Kg per person.

Given the above volume of animal feeds that are being produced, which is expected to go up due to increasing demand from the livestock and particularly, the poultry sectors, and given the direct links between feed safety and the safety of animal source foods, feed production and related feeding practices are now considered as an integral part of the food production chain. With the outbreak of the problems mentioned above, several measures have been taken, more in recent years, to insure that feed production is subject, in the same way as food production, to quality control systems based on risk analysis.

The issue has become so important and so meditated that several international organizations and agencies are actively involved in work related to the safety of animal feedstuffs and implications for animal and human health. They generate and disseminate information on various aspects of feed composition and feed use, including potential food safety hazards linked to feeds. The main goal is to provide technical assistance to countries, aimed at improving feed production, feeding practices and feed control programs. The Codex Alimentarius Commission (CAC) jointly established by FAO and WHO has adopted standards, guidelines and recommendations relating to the quality and safety of animal feeds and human food of animal origin. Codex (2002) can be consulted for details.

In addition, FAO (Animal Production and Health Division), recognizes that if BSE exists within a country, it will not be only a problem of animal health but a grave concern due to the potential transmission of the disease to humans. In addition, severe implications for the meat production sector can be expected, including serious economic consequences. FAO has for example, issued a press briefing in January 2001 that urged countries around the world to be concerned about BSE and its human form. After analysis of the world trade situation, It suggested that all countries that have imported cattle or blood and bone meal from Western Europe, especially the UK, during and since the 1980s, can be considered at risk of BSE related diseases. The FAO statement added that countries at risk should implement effective surveillance for BSE (laboratory testing of samples from slaughtered cattle, correct disposal of fallen stock, improved processing of slaughter by-products, HACCP systems through the food chain...). Some other issues include the production of animal feed, the raw ingredients used, labelling of manufactured feeds, transport systems, slaughtering methods, disposal of waste materials, legislative aspects (Speedy and Battaglia, 2002). FAO recommends also a precautionary ban on the feeding of any protein sources from mammalian or avian origin. To achieve this, an effective capacity building and training programs for operative and government officials is required, and FAO Animal Production and Health Division is currently putting in place regional and national projects (Eastern Europe, Africa) to assist with capacity building for surveillance and prevention of BSE and other zoonotic diseases.

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تأثير التغذية في نوعية المنتجات الحيوانية

مقدمة:

يتطلع العاملون في مجال الثروة الحيوانية إلى توفير المنتجات اللازمة للاستهلاك البشري
وتختلف درجة النجاح في الوصول إلى هذا الهدف باختلاف البلدان.

وفي جميع الحالات كان اهتمام الباحثين ينصب على المقاييس الكمية في تقييم الإنتاج وتقدير الاحتياجات أكثر من الاهتمام بالمقاييس النوعية لأن حجم المشكلة الغذائية كان ومازال يبدو كبيراً لسببين أو حقيقتين هما:

١ - **الزيادة المطردة في عدد السكان** والمتلازمة مع زيادة الاحتياجات من المنتجات الحيوانية.

٢ - **انخفاض المساحات الزراعية** المستمر لحساب القطاعات الأخرى (إسكان، مواصلات، صناعات، خدمات، زحف الصحراء... الخ) الذي ينعكس سلباً على نمو الثروة الحيوانية.

لذلك انحسرت النشاطات في حدود الاحتياجات الكمية من المنتجات لمواجهة المستقبل الذي ينذر باتساع الفجوة بين المنتج والاحتياجات.

ونشطت الأبحاث في مجال استنباط أو تطوير مصادر أخرى غير تقليدية للبروتين مثل:

(وحيدات الخلايا، مخلفات الأسماك، الصويا، الحشرات).

وتحققت بعض النجاحات في مجالات تغذية الحيوان، ولكن مازال مطلوباً الكثير في مجالات:

١ - تطوير الكفاءة التحويلية للأعلاف إلى منتجات حيوانية.

٢ - تحسين نوعية المنتجات الحيوانية (لتكون أكثر كفاءة في تغطية احتياجات الإنسان الغذائية).

٣ - تدقيق وتطوير المقننات الغذائية الموضوعة للحيوانات الزراعية وللإنسان.

سبل تطوير كفاءة التغذية لزيادة وتحسين المنتجات?ةيناويحلا

١ - الإدارة والرعاية:

٢ - التربية:

- تحسين كفاءة السلالات الوراثية.
- تحسين نوعية النمو وتركيبه .
- تحسين الكفاءة التناسلية لبعض الأنواع.

٣ - التغذية :

ومحاورها متعددة نتناول منها:

F.El-Yassin: Professor of Animal Nutrition, Aleppo University, Aleppo, Syria.

أولاً- تقدير الاحتياجات الغذائية وتقييم مواد العلف:

- يحتاج إلى إعادة نظر وتقييم.(FM & BM)
- مراعاة التداخل بين الاحتياجات للأغراض المختلفة (صيانة، نمو، إنتاج، تناسل)
- مراعاة نوعية الاحتياجات وأثر اختلاف مصادر الطاقة ومصادر البروتين
- اعتماد نوعية البروتين ومحتواه من الأحماض الأمينية بدلاً من DCP أو CP
- وضع المقننات لإعطاء إنتاج نوعي إضافة إلى كمية الإنتاج.

ثانياً- أثر التغذية في إنتاج الحليب وقيمته الغذائية:

١ - الفيتامينات:

- تصل الفيتامينات إلى الغدد اللبنية مع الدم، ولا تتكون فيها.
- الحليب مصدر هام لفيتامين A وفقير بفيتامينات C و D ويحوي آثار من E و K.
- يحسب نسب متفاوتة وغير ثابتة من فيتامينات B.

فيتامين A :

- أهم مصادره الكاروتين المنتشر في الأعلاف الخضراء.
- حليب الربيع يحوي كاروتين + الفيتامين
- تخزن الزيادة من الكاروتين في الكبد ٥٠ و ٢٠٠ ميكروغم/غ كبد للأبقار والأغنام)
- الحد الأدنى لتركيزه في الدم ٢٥٠٠ ميكروغم/لتر (العوز عند ١٥٠٠ ميكروغم).

الأسئلة التي تحتاج إلى إجابة:

- متى يبدأ استخدام مخزون الكبد من الفيتامين وعند أي تركيز في؟مدلا
- هل يفرز الفيتامين مع الحليب إذا كان مصدره الجسم كما لو كان مصدره؟ءاذغلا
- هل يستخدم الاحتياطي للتفاعلات الأساسية فقط ولا يستخدم؟جاتنلإا
- متى يكون الحليب فقرياً بالفيتامين وما هو أثر ذلك في قيمته؟ةيئاذغلا

فيتامينات B:

- معظم أنواع الحليب فقيرة بحمض الفوليك ، B12 و البيرودوكسين (B6)
- ويعتبر حليب الأبقار أغنى من حليب الماعز بهذه الفيتامينات.
- القاعدة العامة أن المجترات لا تحتاج إلى فيتامينات B في علائقها.

النياسين :

- له أهمية كبيرة في الاستقلاب، خاصة عند البكاكير في الموسم الأول.
- مهم لاستقلاب الطاقة في الكرش.
- يقي من الكيتوزيس.
- يزيد إنتاج البروتين الميكروبي.

- يزيد هضم الألياف ← زيادة في إنتاج الحليب ونسبة الدهن.
- الأبقار الحلوب تحتاج ٣ - ٦ غ/يوم لتنظيم استقلاب الطاقة.

الكولين:

تبين أنه ضروري للأبقار الحلوب.

- عند إعطائه مع العليقة ← زيادة طفيفة في الإنتاج ونسبة الدهن.
- عند إعطائه في المعدة الحقيقية يؤدي الى:

زيادة ١٤% بالإنتاج وارتفاع نسبة الدهن من ٢,٥٥ - ٢,٩%.

- هذا يؤكد ضرورة دراسة أهمية جميع فيتامينات B واحتياجات المجترات منها وطرق إضافتها.

المطلوب لإنتاج حليب صحي :

- علائق غنية بفيتامينات E D A
- إضافة فيتامينات B التي ثبتت أهميتها .
- دراسة مدى الحاجة للفيتامينات الأخرى من المجموعة B .
- تحديد أفضل طرق إضافتها لضمان وصولها الى الدم .

البروتينات:

- القاعدة العامة أن المجترات غير حساسة لنوعية البروتين،
- تناسبها نوعية البروتين الميكروبي.
- البروتين الميكروبي فقير (مثيونين، لايسين، ثريونين).
- القيمة الحيوية للبروتين الميكروبي (متوسطة – جيدة) تناسب ذوات الإنتاج المتوسط.
- لتغطية الفجوة الكبيرة في البروتين ، لا بد من تربية حيوانات ذات إنتاج عالي .

إن نسبة ونوعية بروتين العليقة تؤثر في كمية الحليب المنتج، وتؤثر في نسبة الدهن في الحليب بمعدل أكبر من تأثيرها في نسبة البروتين

جدول (١) تأثير نسبة ونوعية العليقة في إنتاج ونوعية الحليب

نسبة البروتين/العليقة (%)	مصدر البروتين	الإنتاج كغ حليب (%)	نسبة الدهن (%)	نسبة البروتين (%)
١٤,٥	شاهد	١٩,٣ (١٠٠%)	٤,٣٨(١٠٠%)	٢,٩٣ (١٠٠%)
١٨,٤	صويا	٢٢,٣ (١١٦%)	٤,١٥ (٨٩%)	٣,٠٨ (١٠٥%)
١٨,٤	طحين وسمك	٢٣,٤ (١٢١%)	٤,٢١ (٩٦%)	٣,٠١ (١٠٣%)

عن Thomas & Chamberlain (١٩٨٧)

يختلف تأثير الإضافة البروتينية حسب مصدرها ونوعها:

- زيادة نسبة البروتين ← زيادة الإنتاج، نقص نسبة الدهن، زيادة نسبة البروتين.
- طحين السمك ← زيادة الإنتاج أكثر من الصويا.
- الصويا ← نقص أكبر في نسبة الدهن وزيادة أكبر في نسبة البروتين.

إن إضافة الأحماض الأمينية الحرة حقناً بالمعدة لتفادي تحللها في الكرش يؤدي إلى اختلاف نسبة البروتين في الحليب (جدول ٢).

جدول (٢): تأثير إضافة الأحماض الأمينية (حقناً في المعدة) في نسبة بروتين الحليب.

نوع الإضافة	التغير في نسبة بروتين الحليب (غ/كغ)
كازين أو مخلوط من ١٠ أحماض أساسية	+ ١,٧
مثيونين	- ٠,٥
لايسين	+ ٠,١
مثيونين + لايسين	+ ١,١
مثيونين + لايسين + ثريونين	+ ٠,٤
مثيونين + لايسين + فالين	+ ١,٤
مثيونين + لايسين + فالين + ايزوليوسين	+ ١,٦
مثيونين + لايسين + فالين + ايزوليوسين + فينايل ألانين	+ ١,٩
مثيونين + لايسين + فالين + ليوسين	+ ١,٥
مثيونين + لايسين + فالين + ليوسين + هستيرين	+ ٠,٩
مثيونين + لايسين + فالين + ليوسين + هستيرين + فينايل ألانين	+ ٢,١

عن (Schwab, et al ١٩٧٦)

- هذه الإضافات لو أعطيت مع العليقة (في الكرش) لما أعطت أية نتائج.
- يلاحظ أن أفضل النتائج التي استخدمت فيها مجموعة من الأحماض.
- هذه الدراسة تحتاج إلى تكرار وتغير في معدلات الأحماض للوصول إلى أنسب توازن بينها.
- وتؤكد أن نوعية البروتين مهمة للأبقار الحلوب.
- يجب تعميق الدراسات في إستقلاب البروتين في الكرش لتحسينها .
- يجب دراسة الاحتياجات النوعية للمجترات من البروتين .

٣- نوعية وتركيب العليقة:

استخدام السيلاج كعلف وحيد:

جدول (٣): أثر نوعية السيلاج في نوعية وإنتاج الحليب.

البيان	نوع السيلاج		
	١	٢	٣
محتوى السيلاج			
%DM	٣٥,٥	٢٤,٦	٢٢,٢
%CP	٢٣,٦	١٨,٩	١٨,٩
N أمونياكي (% من الكلي)	١١,٤	١٣,٤	١٢,٩
ME (MJ /كغ DM)	١١,٥	١١,٥	١٠,٦
الإنتاج (كغ حليب)	٢٣,١	٢١,٨	١٩,٤
نسبة الدهن %	٤,٠٥	٣,٩٣	٣,٦٢
نسبة البروتين %	٣,١٨	٢,٩٩	٢,٧٢

عن (Rae, et al. ١٩٨٦)

- انخفض الإنتاج نتيجة انخفاض نسبة المادة الجافة والطاقة (٣).
- انخفضت نسبة الدهن والبروتين بمعدل حوالي ١٠% نتيجة انخفاض مستوى الطاقة.
- انخفاض نسبة البروتين (٢) أدى إلى نقص الإنتاج ونسبة البروتين مقارنة مع (١).

وعند استخدام الإضافات المركزة إلى السيلاج النجيلي ازداد إنتاج الحليب ونسبة الدهن والبروتين فيه (جدول ٤).

جدول (٤) تأثير الإضافات المركزة في إنتاج ونوعية حليب الأبقار

السيلاج (كغ/يوم)	الإضافات المركزة (كغ/يوم)	الإنتاج (كغ/يوم)	دهن (%)	بروتين (%)	لاكتوز (%)
١١,٤	لا يوجد (شاهد)	١٥,٨	٣,٧٨	٢,٩٥	٤,٧٩
١٢,١	٠,٨ طحين سمك + ٠,٤ كسبة صويا	٢٠,٩	٣,٧٥	٣,١٧	٤,٧٤
١٠,٤	٤,٣ خلطة مركزة (حبوب)	٢١,٣	٤,٢٢	٣,٠٧	٤,٨٥

- جميع الإضافات أثرت إيجابياً في كمية الحليب المنتج.
- الإضافات البروتينية أثرت إيجابياً في نسبة البروتين.
- إضافة الحبوب أثرت إيجابياً في نسبة الدهن.

تختلف نوعية الحليب باختلاف نوعية العليقة:

- فلا تستوي نوعية حليب أبقار تتغذى على السيلاج مع أخرى تتغذى على الدريس.

- وتتأثر نوعية الحليب بنسبة العلف المركز الى الخشن وبنسبة النشا أو الألياف في العليقة (جدول ٥).

جدول (٥): تأثير نسبة الدريس ونسبة ونوعية العلف المركز في إنتاج الحليب ونسبة الدهن به.

تركيب العليقة	الإنتاج (كغ/يوم)	% دهن
١- ٢٠% دريس + ٨٠% مركز غني بالنشا	٣٢,٠	٢,٢٦
٢- ٢٠% دريس + ٨٠% مركز غني بالألياف	٢٥,٥	٣,٦٢
٣- ٤٠% دريس + ٦٠% مركز غني بالنشا	٢٦,٣	٤,١٥
٤- ٤٠% دريس + ٦٠% مركز غني بالألياف	٢٦,٥	٤,٢٩

١- عليقة فقيرة جداً بالألياف ← إنتاج عالي ودهن منخفض.

٢- زيادة الألياف ← إنتاج حليب منخفض مع زيادة في نسبة الدهن.

يؤدي اختلاف تركيب العليقة ونسب وأنواع الأعلاف المركزة الخشنة إلى اختلاف نواتج الهضم والتخمر في الكرش وبالتالي اختلاف طبيعة الاستقلاب، والتفاعلات بين هذه النواتج.

إن أهم نواتج الهضم التي تمتص من الكرش والأمعاء (الخلات، البريبونات، البيوتران، الجلوكوز، الأحماض الأمينية، الأحماض الدهنية... وغيرها).

والعلاقة بين هذه المركبات هي المعنية بالتوازن الغذائي، وتوصيف مثل هذا التوازن أمراً صعباً للغاية. وتحديد أفضل العلاقات بين هذه المركبات لإعطاء أفضل إنتاج مازال يحتاج إلى الكثير من الدراسات.

وقد فرزت بعض الدراسات التي استخدمت فيها إضافات نقية من بعض المركبات نتائج قيمة (جدول ٦).

جدول رقم (٦): تأثير إضافة بعض المركبات في إنتاج وتركيب الحليب.

المركبات	تأثير الإضافة (% من الشاهد)		
	إنتاج الحليب	نسبة الدهن	نسبة البروتين
خلات	+ ٨,٣	+ ٨,٩	- ١,٢
بروبيونات	- ١,٦	- ٨,٣	+ ٦,٥
بيوترات	- ٤,٩	+ ١٤,٢	+ ٢,٢
أحماض دهنية (طويلة)	+ ٢,١	+ ١٣,١	-
جلوكوز	+ ٥,٥	- ١٠,٣	- ١,١
أحماض أمينية	+ ٧,٢	- ٢,٥	+ ٥,٩

عن Thamas & Marcin (١٩٨٨)

- زيادة الخلات والجلوكوز والأحماض الأمينية ← زيادة في كمية الإنتاج.
- زيادة الخلات والبيوترات والأحماض الدهنية ← زيادة في دهن الحليب.
- زيادة البروتينات والأحماض الأمينية ← زيادة في بروتين الحليب.
- زيادة البروبيونات والجلوكوز ← نقص في دهن الحليب.

وفي دراسة على الماعز وجد Fehr & Sauvant (١٩٧٩) أن مستوى ومصدر طاقة العليقة يؤثر في نوعية الأحماض الدهنية المكونة لدهن الحليب.

زيادة استهلاك الطاقة ← زيادة نسبة البالماتيك بنسبة كبيرة.

وبنسبة أقل زيادة نسبة الأحماض الحاوية أقل من ١٦ ذرة C.

زيادة استهلاك الطاقة ← نقص نسبة الأحماض الحاوية ١٨ ذرة C (ستياريك وأوليك)

نقص الدهن في العليقة ← نقص نسبة الأحماض الحاوية ١٨ ذرة C (ستياريك وأوليك)

زيادة الدهن في العليقة ← نقص إنتاج الحليب ونقص نسبة الدهن.

مما سبق يتضح أن التغذية تؤثر في :

- معدلات الإنتاج من الحليب.
- نسبة الدهن في الحليب.
- نسبة البروتين في الحليب ونوعيته ومحتواه من الأحماض الأمينية.
- تركيب الدهن ومحتواه من FA/وبخاصة نسب EFA.
- نوعية الدهن وحجم حبيباته، ونسبة الأحماض القصيرة (٤ - ١٢ ذرة C) (معدل الهضم).
- نوعية الخثرة وحجم جزيئاتها وقابليتها للتفتت بفعل البروتين.
- محتوى الحليب من الفيتامينات.

يستنتج من كل ذلك أن:

- القيمة الغذائية لحليب النوع الواحد ليست واحدة.
- يجب تعميق طرق قياس القيمة الغذائية على ضوء النوعية.
- يجب تعميق طرق تقدير الاحتياجات الغذائية من جميع المواد الغذائية.

فمثلاً تتساوى قيم الطاقة (GE) في حليب الأم مع حليب الأغنام والماعز (٧٥٠ Kcal /كغ). ولكن قيم الطاقة الصافية (NE) تختلف لاختلاف مصادر الطاقة الكلية في أنواع الحليب.

نوع الحليب	مصادر الطاقة ونسبها		
	دهن	بروتين	سكر
أبقار وماعز	%٥٠	%٢٥	%٢٥
الأم	%٥٥	%٧	%٣٨

يحوي كل من حليب الماعز والأبقار معدلات من EAA أعلى من احتياجات الطفل حسب المقننات المعتمدة. (الشكل ١)

- يحوي حليب الأبقار نسب أعلى لجميع الأحماض من حليب الماعز وكلا الاثنين يغطي الاحتياجات. ولكن التجارب تبين أن البروتين المحتجز من حليب الأبقار أعلى عند الأطفال. مما يشير إلى أن الاحتياجات المقدرة للأطفال من الأحماض الأمينية تحتاج إلى تدقيق.

أثر التغذية في إنتاج ونوعية اللحم

تتغير خصائص اللحم بتأثير عوامل عديدة جداً:

- الحيوان (النوع، السلالة، العمر، الوزن، أجزاء الذبيحة)
- التغذية (الطاقة، البروتين، العناصر المعدنية والفيتامينات، الإضافات غير الغذائية... الخ).
- اقتصاديات التسمين .
- تجهيز وتصنيع اللحوم للاستهلاك.

كما تختلف الأذواق والعادات في تفضيل أنواع اللحوم، لذلك يصعب تحديد المواصفات المثلى للحوم، وسنكتفي باستعراض موجز لتأثير بعض العوامل في نوعية اللحم.

جدول (٧) : تأثير العمر والوزن الحي في تركيب الذبيحة عند الخراف

العمر (يوم)	الوزن (كغ)	مادة جافة (%)	محتوى المادة الجافة		
			دهن%	بروتين %	طاقة (Kcal/غ)
عند الولادة	٣,٠٥	٢٢,٦	٨,١	٧١,٧	٤,٧
٦٠	٢٢,٥	٤٠,٥	٥٢,٢	٣٧,١	٦,٦
١٢٠	٣٥,٢	٤٤,٦	٥٩,٥	٣١,٢	٦,٩

جدول (٨) :تأثير نسبة بروتين العليقة في نسبة الدهن والآزوت في الذبيحة (%)

	الوزن (كغ)	نسبة بروتين العليقة (%)		
		١٠	١٥	٢٠
N الذبيحة %	٢٧,٥	٦,٦٥	٨,٤٥	٩,١٤
	٤٠	٤,٨٢	٥,٧٨	٥,٩٧
دهن الذبيحة %	٢٧,٥	٤٩,٩	٣٩,٠	٣٢,٦
	٤٠	٦٢,٠	٥٥,٣	٥٥,٥

نوعية دهن الذبيحة من الخصائص المهمة في تحديد القيمة الغذائية للحوم

تبين من نتائج تسمين عجول وثيران ذبحت عند وزن ٣٦٥ - ٤٠٠ كغ أن :

- عينات عضلات العجول والثيران السمينة احتوت (٥١ - ٦٣% أحماض غير مشبعة)
- عينات دهن العجول والثيران السمينة احتوت (٤١ - ٥٠% أحماض غير مشبعة).
- عضلات الثيران احتوت ضعف عضلات العجول من:
  اللينوليك (٢ : C. ١٨) و اللينولينك (٣ : C. ١٨)
- عينات الثيران احتوت أقل قليلاً من:
  البالماتيك (٠ : C. ١٦) والميريستيك (٠ : C. ١٤) التي يعتقد أنها لها دور هام في زيادة تركيز الكولسترول في الدم.

- المشكلة في إنتاج اللحوم تتلخص في <u>صعوبة ضبط العلاقة بين كمية الإنتاج ونوعيته.</u>
- **زيادة الإنتاج :** يجب أن <u>تبقى هدفاً أساسياً</u> لمواجهة العجز
- **تحسين النوعية :** يجب أن <u>تصبح هدفاً أساسياً</u> وأهم عناصرها:
  - نسبة البروتين : الدهن.
  - نوعية البروتين: وبخاصة محتواه من الأحماض الأمينية (EAA)
  - نوعية الدهن: وبخاصة محتواه من (SFA , UnSFA , EFA والمواد الضارة)
  - الاستساغة والخصائص الفيزيائية والكيميائية.
  - خلو المنتج من المواد الضارة بالإنسان .

تحسين النوعية كثيراً ما يتعارض مع زيادة كمية الإنتاج، فهو يحتاج:

- إلى نوعية ونظم تغذية عالية التكلفة.
- زيادة أعداد الحيوانات (مشكلة صعبة الحل عندما تكون الأبقار المصدر الأساسي للحوم).
- خصائص وراثية مميزة عند الحيوانات.

فهل يمكن الوصول للإنتاج المتميز من الناحيتين الكمية والنوعية معاً ؟؟.

مثال للبحث عن النوعية بعيداً عن باقي الاعتبارات إنتاج // VEALE CALVES //

(نوعية وخصائص ممتازة)- (١٠ كغ حليب / كغ وزن حي)

١٠٠٠ كغ حليب تحوي ٣٥ كغ دهن حليب و ٣٠ كغ بروتين حليب

تدخل دورة تغذية جديدة لتعطي : لحم يحوي ١٥كغ بروتين و٥ كغ دهن !!!!!

منذ أكثر من ٣٠ سنة كان الهدف أمام الاختصاصين والمنتجين :

- استخدام الأعلاف غير الصالحة للاستهلاك البشري في تغذية الحيوان .(عدم المنافسة)
- تحسين الكفاءة التحويلية (FE) لهذه الأعلاف حتى :

٢,٤ / ١ عند الدواجن، و ٣ / ١ عند الخنزير، و ٣,٥ / ١ عند أبقار اللحم.

وقد أمكن الاقتراب من الهدف في بعض المناطق وفق المقاييس الكمية ((وزن / وزن))
ولكن مازال الهدف بعيداً والإنتاج بدائياً وفق جميع المقاييس في الكثير من المناطق .

ويجب أن يكون الهدف المستقبلي :

- لتركيز على نوعية الإنتاج مع كميته في وقت واحد.
- تحسين الاستفادة من الأعلاف بجميع الوسائل :
(كفاءة الحيوان – دقة الاحتياجات - الإستقلاب – نوعية الأعلاف-الإدارة والاقتصاد ...الخ)
- تطوير تقنيات تجهيز وتصنيع المنتجات .
- تطوير تقنيات وتشريعات مراقبة وتقييم المنتجات .
- تجنب خطر المواد الضارة في الأعلاف وفي المنتجات الغذائية
- الاعتماد على البحث العلمي في حل جميع المشاكل.

المراجع العلمية
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II
Consultation Presentations

LADA, DEGRADATION ASSESSMENT AND SUSTAINABLE LAND MANAGEMENT

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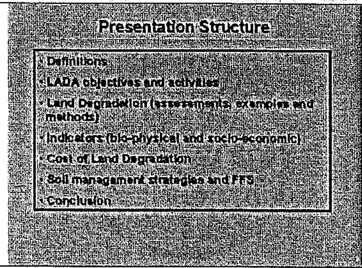

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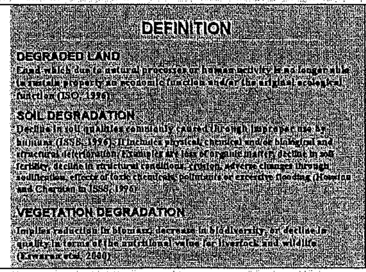

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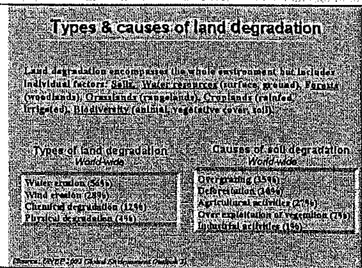

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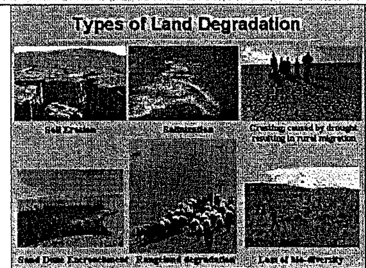

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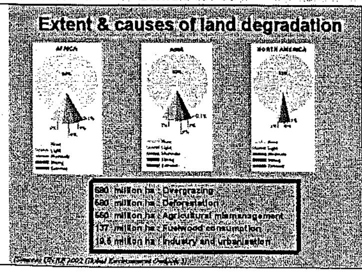

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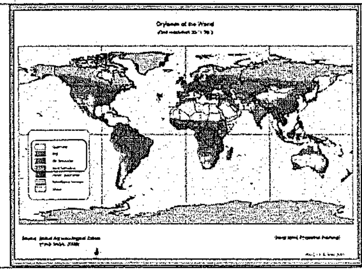

H. Nabhan: Senior Officer (Soil Management), Land & Water Development Division, FAO, Rome

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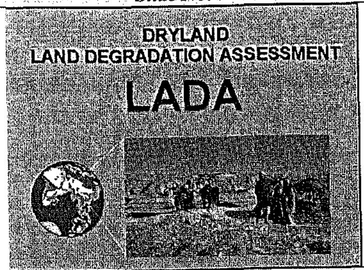

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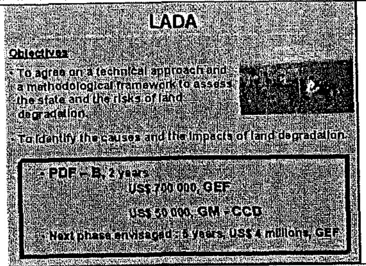

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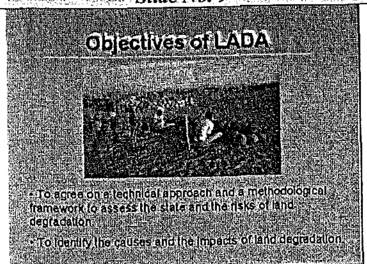

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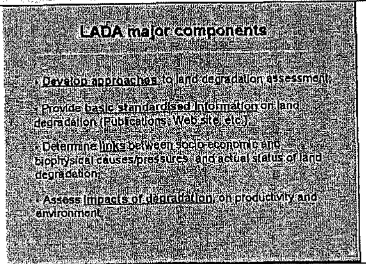

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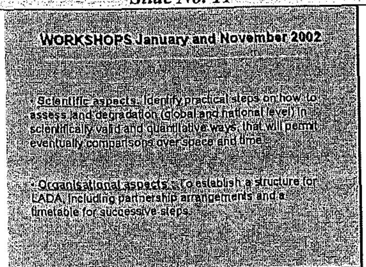

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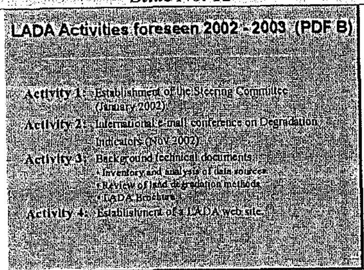

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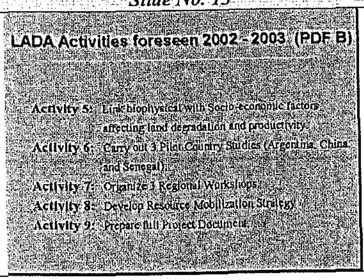

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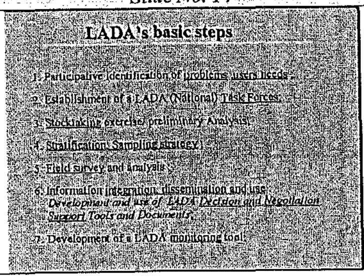

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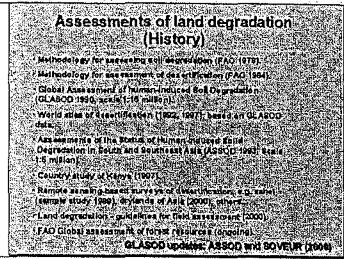

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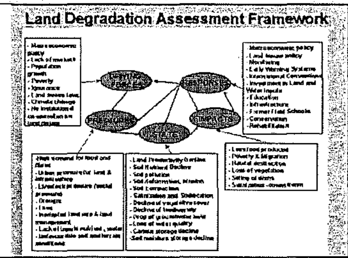

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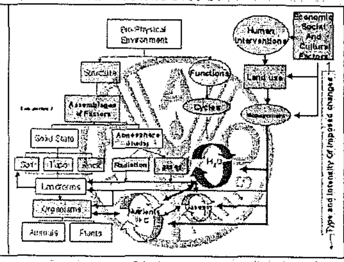

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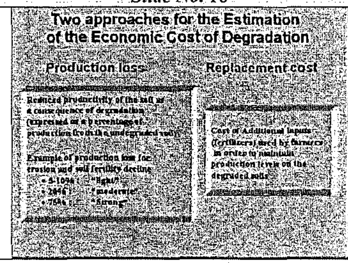

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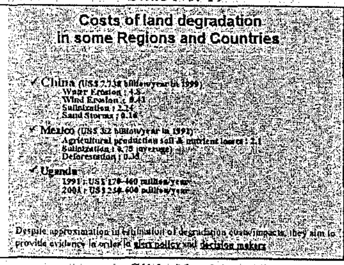

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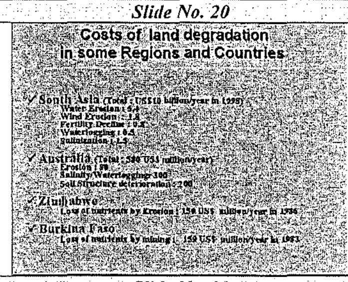

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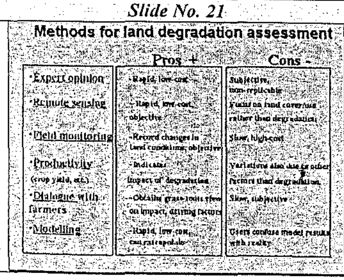

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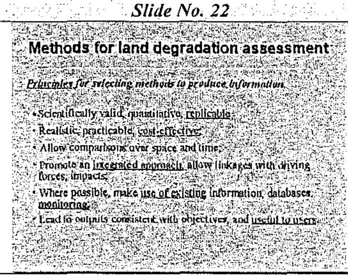

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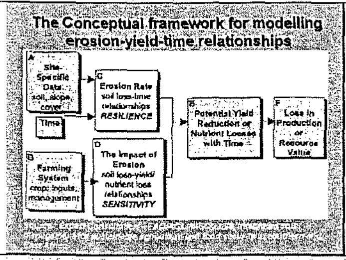

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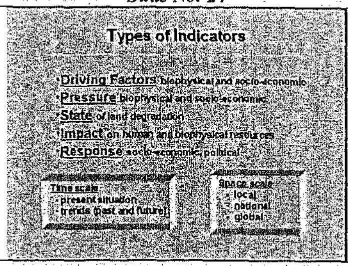

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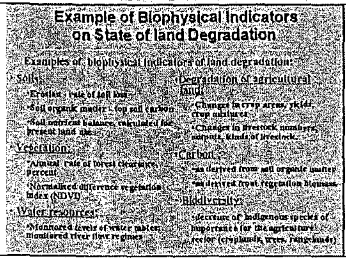

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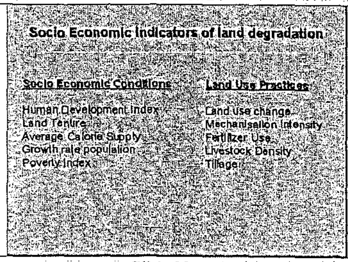

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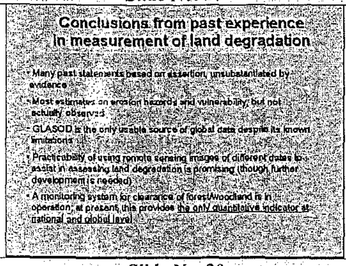

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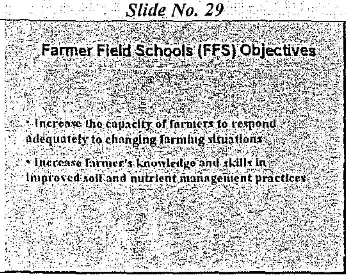

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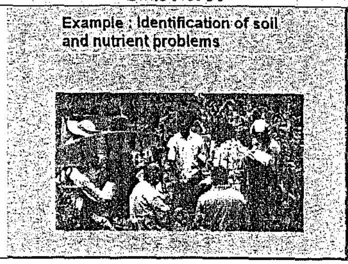

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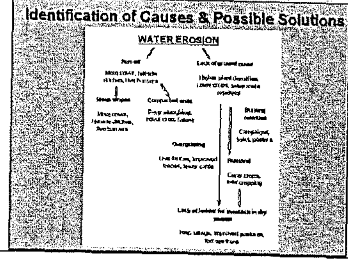

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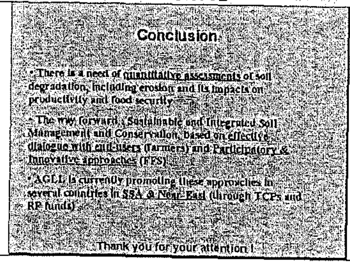
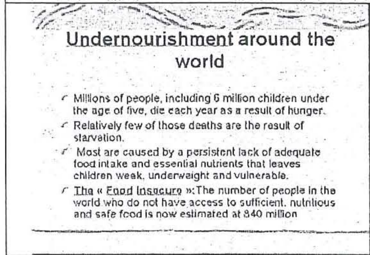


FOOD CHAIN: THE IMPACT ON HUMAN NUTRITION

Slide No. 1



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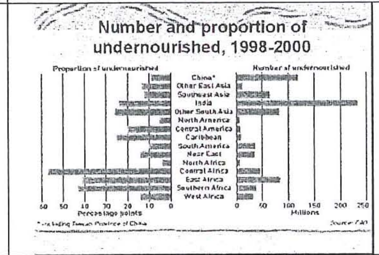

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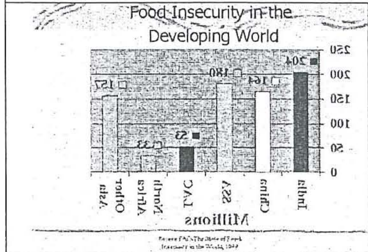

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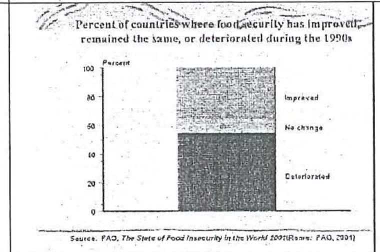

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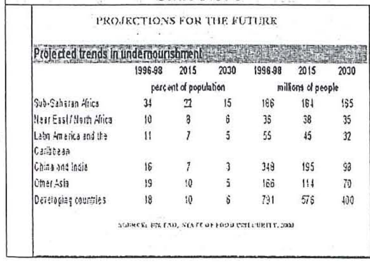
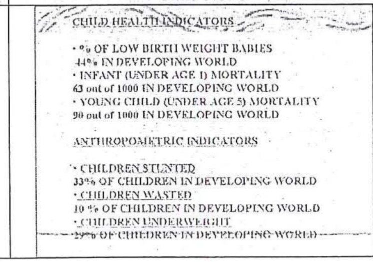

PROJECTIONS FOR THE FUTURE

Projected trends in undernourishment

	1996-98	2015	2030	1996-98	2015	2030
	percent of population			millions of people		
Sub-Saharan Africa	34	22	15	186	184	165
Near East/North Africa	10	8	6	36	38	35
Latin America and the Caribbean	11	7	5	55	45	32
China and India	16	7	3	348	195	98
Other Asia	19	10	5	166	114	70
Developing countries	18	10	6	791	576	400

Slide No. 6



Slide No. 7

ESTIMATED PREVALENCE OF UNDERWEIGHT, STUNTED AND WASTED CHILDREN, 1996-2000

Region/country group	Underweight[1] (weight-for-age)	Wasted[1] (weight-for-height)	Stunted[1] (height-for-age)
	(Percentage)		
Sub-Saharan Africa	31	10	37
Near East and North Africa	17	8	24
South Asia	49	17	48
East Asia and the Pacific	19	6	24
Latin America and the Caribbean	9	2	[illegible]
Developing countries	29	10	33
Least developed countries	40	12	45

[1] Defined as < 2 standard deviation (SD) from the median of reference values.

Source: UNICEF.

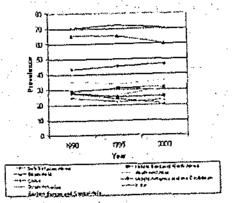
Slide No. 8

Micronutrient Deficiencies

- About 2 billion people suffer from iron-deficiency anemia
- More than 2 billion people at risk of iodine-deficiency disorder
- 250 million preschool children affected by severe vitamin-A deficiency
- Extent of other micronutrient deficiencies (e.g., zinc, riboflavin, calcium) unknown.

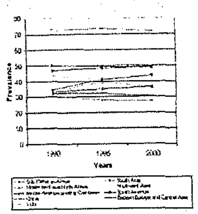
Slide No. 9

Trends in the prevalence of iron deficiency in non-pregnant women of reproductive age, 1990-2000.



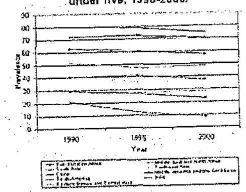
Slide No. 10

Trends in the prevalence of iron deficiency among pregnant women, 1990-2000.



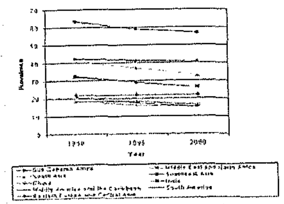
Slide No. 11

Trends in the prevalence of iron deficiency in children under five, 1990-2000.



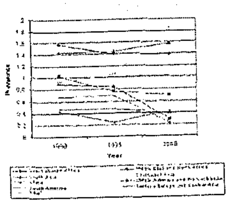
Slide No. 12

Trends in the prevalence of sub-clinical vitamin-A deficient children, 1990-2000.



Slide No. 13

Trends in the clinical prevalence of vitamin A deficient children, 1990-2000.



Slide No. 14

Where Are We Heading?

There is no possibility of achieving food security for all by 2020

- Number of malnourished children will decline by only 20% by 2020
- Number of food-insecure people will decline from 780 to only 675 million by 2015
- The goal of cutting hunger in half will only be reached by 2050

Slide No. 15

Nutrition and Food Supplies

- Is the planet running out of food?
- World food supplies have more than kept up with human population growth over the past two centuries.
  - 1950 - 2.5 billion people - average daily diet was less than 2,000 calories/person.
  - 2001- 6.0 billion people - world food supply can provide more than 2,500 calories/person.
  - In some specific regions, however, food production has not kept up with population growth (e.g. sub-Saharan Africa)

Slide No. 16

Nutrition and Food Supplies

- If food supply is doing fine, why is there hunger, malnourishment, and famine?
  - Food is not distributed equally
  - Global food systems are failing to provide adequate quantities of essential nutrients and other factors needed for good health, productivity and well being in many developing nations.
  - Nutrition transitions are causing increased rates of chronic diseases (cancer, heart disease, stroke, diabetes, osteoporosis)
  - *Green revolution* cropping systems have resulted in reduced food-crop diversity and decreased availability of micronutrients

Slide No. 17

Food and Agriculture Organization (FAO)

-To feed a world of 9 billion people in 2050, without allowing for additional imports of food: *Africa has to increase its food production by 300 percent; Latin America by 80 percent; and Asia by 70 percent.* ***Even North America would have to increase food production by 30 percent to feed its own projected population of 348 million"***

•Without an Increase in Farm Productivity, Additional 1.6 Billion Hectares of Arable Land will be Needed by 2050!

Slide No. 18

Why Developing Countries Have Problems with Food?

- Limited Resources
- Low Agricultural Productivity
- Diminishing Productive Land
- Poverty; Poor Distribution of Food
- Protectionist Policies
- Misguided Priorities
- Low Agenda of Ag Res and Dev
- Growing Population
- Low Purchasing Power
- Civil Strife, War

Slide No. 19

Green Revolution...

- **Lifted Billion Plus Out of Poverty**
- **Undernourished > from 38% to 19% in past 20 years**
- **Food Consumption per capita has increased everywhere except in Africa - 18% Globally and 28% in LDCs**
- **India: Food production from 50 to 205 mil tons in the past 5 decades. Wheat : from 6 to 82 million tons per year!**
- **Less Starvation and Famine**
- **Increased Food Self Sufficiency**

Investments in Agricultural Research has Returned73% Annually! (Alston et al., 1998)

Slide No. 20

But Green Revolution...

- Focused on Few Grain Crops.....Wheat, Rice, Corn
- High Inputs - Fertilizer, Pesticide
- Crop Yield - the Major Goal
- Little Impact in Sub-Saharan Africa

Slide No. 21

Food Sources

- What do people eat?
  - About a dozen types of seeds and grains, three root crops, twenty or so common fruits and vegetables, six mammals, two domestic fowl, and a few fish and other forms of marine life.
  - Wheat, rice, and maize (corn) are the most important staple foods - wheat and rice account for 60% of the calories consumed directly by humans.
  - Other grains and vegetables are locally important

Slide No. 22

How can agriculture contribute?

- Holistic, sustainable improvements in the entire food system are required to solve the massive problem of malnutrition and increasing chronic disease rates in developed and developing countries.
  - Food Supply & Food Sources
  - Soil - use degradation and conservation
  - Land Resources
  - New Crops/Genetic Engineering
  - Sustainable Agriculture

Slide No. 23

Food sources

- North America, Europe and Japan make up 20% of the world population, and consume 80% of world's meat and milk.
  - For cattle, you need 16 Kg of feed to make 1 Kg of meat.
- 90% of the grain grown in North America is used to feed dairy and beef cattle, hogs, poultry, and other animals!
- If we ate the grain directly, we would obtain twenty-one times more calories and eight times more protein than we get from eating the beef.

Slide No. 24

Food sources

- Fish provide important protein worldwide. What are some of the problems with fisheries?
  - Annual catch rose about 4% every year from 1950-1988, but ...
  - some major marine fisheries have declined or become commercially inviable since 1989.
  - Technology change has made fishing much more efficient, and therefore much more successful at depleting fish stocks.

Slide No. 25

Land Resources

- Some countries are rapidly expanding farmland (fastest growth has been in South America)
- Some developing countries are reaching the limit of opening new lands!!
- some important issues related to agriculture:
  - Erosion
  - Water problems
  - Fertilizer use

Slide No. 26

New Crops – Green Revolution

- **Benefits**
  - Improved per capita production
  - Reduced unit costs and prices
  - Increased incomes and purchasing power for farmers and consumers
  - Restrained expansion into forests, grasslands, and wildlife habitats, helping to avert natural resource degradation
- **Costs**
  - Increased soil salinity and lowered water tables in irrigated areas
  - Exacerbated health and environmental problems through inappropriate use of fertilizers and pesticides

Slide No. 27

Sustainable Agriculture

- Conserving soil, water, and nutrients, providing ground cover, etc.
- Can it produce enough food?

Slide No. 28

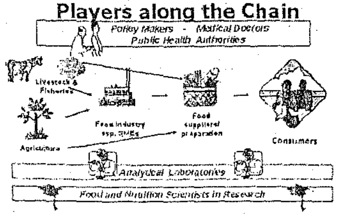
Increasing Agricultural Productivity is the Key to Food Security in the Developing World

- Agriculture is the "*Life Blood*" of most countries
- One-third of GDP
- 70% of People in Farming
- Major Share of Exports

Sustainable Agriculture Development is the Key To Poverty Alleviation, Food Security and Environmental Protection

Slide No. 29

Players along the Chain



Slide No. 30

Agricultural Approaches to Healthier Plant Foods

- Field Site Selection
- Agronomic Practices
  - macronutrient fertilizers
    - nitrogen, phosphorus, potassium, sulfur, calcium, magnesium
    - Effect on protein, fats, vitamins, antinutrients, etc.
  - micronutrient & trace element fertilizers
    - Zn, Ni, I, Mo, Se – effective in increasing amount in plant seeds and grains
    - Fe, Cu, Mg, Cr, V, Si – not effective in increasing seed or grain levels

Slide No. 31

Agricultural Approaches to Healthier Plant Foods

- Cropping systems
  - Legume- cereal rotations –effects micronutrient content
  - Use micronutrient -dense varieties of food crops
  - Increase production of vegetables, fruits, & legumes
- Utilize indigenous plant foods and diversify food systems
- Genetically modify food crops to improve nutrient output of farming systems

Slide No. 32

Effects of N & K Fertilizers on Vitamin C

(mg/100g fr. Wt.)

Vegetable	N_1	N_2	N_3
Swiss chard	47.8	54.1	47.6
Kale, collards	113	112	98
Brussels-sprouts	112	101	93
Vegetable	K_1	K_2	K_3
Swiss chard	49.2	54.1	59.3
Kale, collards	98	112	118
Brussels-sprouts	88	101	100

(Data from Salunkhe and Deshpande, 1991)

Slide No. 33

Effects of N & Harvest Date on Carotene Content of Carrots

Treatment (kg N/pot)	Carotene (mg/100g) 1st harvest	Carotene (mg/100g) 2nd harvest	Carotene (mg/100g) 3rd harvest
0.3	113	125	156
0.6	114	128	158
1.2	125	133	167
2.4	126	133	158

from Habben (1972)

THE ROLE OF ZINC IN PLANT GROWTH AND ENHANCING ANIMAL AND HUMAN HEALTH

ABSTRACT

Micronutrient deficiencies, including zinc, is widespread in plants, animals, and human in the Middle East countries due to the soil calcareousness, high pH, low organic matter, coarse texture, continuous drought, imbalanced application of fertilizers, overuse of P-fertilizers and high bicarbonates in the irrigation water. The absence of micronutrient fertilizers causes low levels of absorption of metal elements by crops. It causes substantial yield losses in different crops, forages, and eventually disturbs animal and human health. Zinc is one of the essential elements for plants, animals and humans, but it is deficient (less than 1.00 mg/kg DTPA-extractable Zn) in most calcareous soils and consequently in plant, animal and human diets. Zinc activates more than 100 enzymes, enhances iron absorption and prevents cholesterol precipitation. It plays an important role in immune system, as well. Hence, zinc deficiency is common in agricultural products of Middle East countries, including Iran and Turkey, where bread and rice are the main staple of the people. Various factors result in low rates of zinc absorption specially due to antagonistic effects and increased levels of phytic acid in the agricultural products that would lead to high molar ratios of phytic acid in the agricultural products that would lead to high molar ratios of phytic acid to zinc (PA/Zn) in wheat grain. Such undesirable practices have led to zinc deficiency in the plants, domestic animals and human's food chain in these countries. However, general awareness hardly exists about this important area of plant-animal-human nutrition.

Application of Zn-fertilizers to soils with zinc deficiency problems has been associated with improved yield and crop quality for cereals, corn, sorghum, beans, forages and the enhancement of domestic animals and human health. Fertilizer application significantly improves the concentration of zinc in cereal grains and reduces PA/Zn molar ratio. Research shows that the application of zinc improves zinc content of wheat grain (enrichment) and enhances animal and human health. Recently about 30,000 tons (1% of the country's total fertilizer use) of zinc sulfate in forms of complete fertilizers, powdered and granulated zinc sulfate have been used in Iran's agricultural sector. The main sources of zinc for human being include red meat, eggs, pumpkin, and squash. People who suffer from zinc deficiency may take 3 zinc sulfate capsules (50 mg Zn) per week but for people with ulcers or prone to this ailment care should be taken by dissolving a capsule's powder in one to two liters of water with orange juice or preferably vitamin C, or using zinc citrate or zinc gluconate instead of zinc sulfate. Smoking and drinking tea immediately after taking meals should be avoided because zinc does not get absorbed in digestive system in the presence of nicotine, theine and phytic acid. Addicts are cautioned against the use of opium as it is also severely interferes with the absorption of zinc. The author himself has not had a cold or loss of a single hair during the past 7 years since he began taking 2 capsules of zinc sulfate per week with meal, even though, he used to have frequent colds, feel tired easily and used to lose hair before taking zinc supplements. As a result of the author's persistence in advocating zinc supplements in Iran, more than 20 million capsules of zinc sulfate are being taken every year as compared to 2 million capsules before 1997. However, a more logical approach would be to enrich the crops, forages, and pastures that are produced in calcareous soils with zinc so that everyone gets the required amount of this essential nutrient in their diets.

M. J. Malakouti: University Professor and Director General, Soil and Water Research Institute, Tehran, Iran

Slide No. 1

- Nowadays our Main Policies in Agricultural Production in these Regions should be:
- Determination of production capacity of soil and water
- Monitoring changes in the quality of soil and water resources under intensive farming to sustain agricultural production.
- Increasing yield and total production of agricultural crops (*from 68 in 2002 to 100 m tones in 2015*), water and fertilizer use efficiency, with due concern about environmental issues.
- Enrichment (*Fortification*) of agricultural products for improving food quality corresponding with known human health principles.

Slide No. 2

•FAO literature indicates that the soil fertility through adding fertilizers was responsible for over 55% of the growth in the agricultural outputs during the last three decades (*Average of 40,000 experiments*) (*Handallah, 2000*). According to FAO calculations, fertilizers account for at least one-third of crop yield increases, sometimes up to half or more in soils depleted of plant nutrients (*Puggina, 2003*)*.

*Handallah, H. 2000. Soil fertility management: The need for new concepts in the region. Soil Fertility Management through Farmers Field School in the Near East Countries. FAO, Amman, Jordan.

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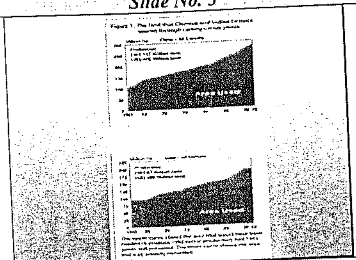


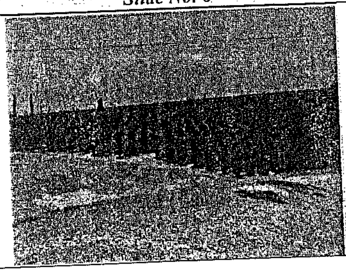
Slide No. 4

Iran covers an area of 1,648,000 km² in Southwest of Asia. From this total, only 15.5 (12-18) mha are under cultivation.

Slide No. 5

- Approximately 90% of the country is arid and semi-arid. The average annual precipitation is about 240 mm and evaporation amounts to 16 times of precipitation.
- Lower rainfall, Global warming, Water scarcity and Salt stress are the main Limiting Factors Threatening Sustained Food Production in our Country.

Slide No. 6



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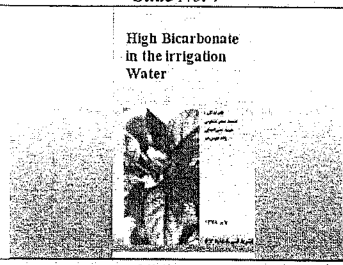

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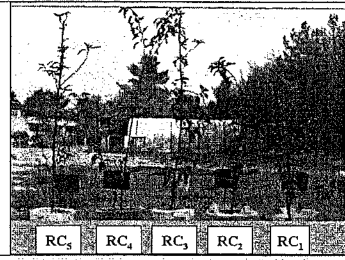


Slide No. 9

Table 1– Percentage of $CaCO_3$, O.C., and available zinc in some orchards in different regions of Iran*.

Region	pH	O. C. (%)	$CaCO_3$ (%)	Zinc (mg/kg)
Damavand	7.9	0.80	20	0.70
Uromieh	7.8	1.30	10	0.80
Maragheh	8.0	0.53	14	0.75
Semirom	7.9	1.15	45	0.50
Mashad	7.8	1.00	30	0.60

*The average amounts of HCO_3^- in irrigation water is about 4.0 meq/li in the studied regions.

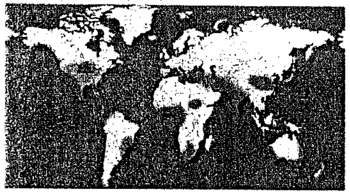
Slide No. 10

So, our Soils are faced with micronutrients deficiencies specially zinc mainly due to:

- High pH,
- High $CaCO_3$,
- Low organic matter,
- High bicarbonates in the irrigation water,
- Over use of P-fertilizers,
- High temperature,
- Continuous drought and
- Absence of micronutrient-fertilizers in the farmers' conventional fertilization practices.

Slide No. 11

World Zinc deficiency in soil.
major areas of reported problems



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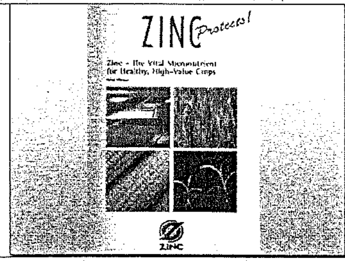

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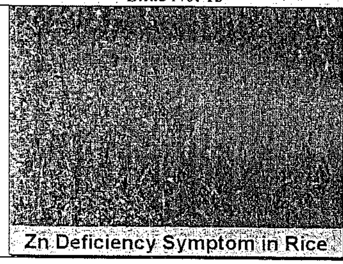

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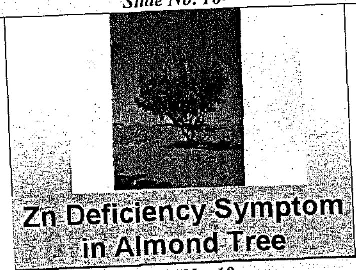

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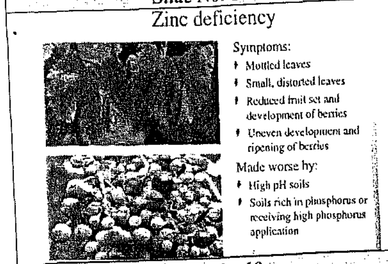

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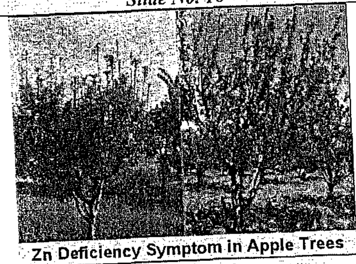

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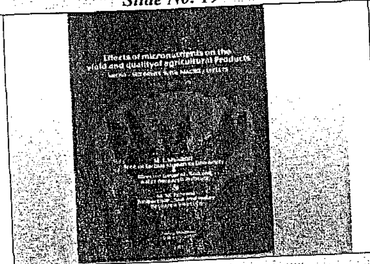

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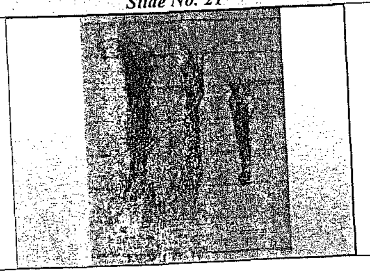

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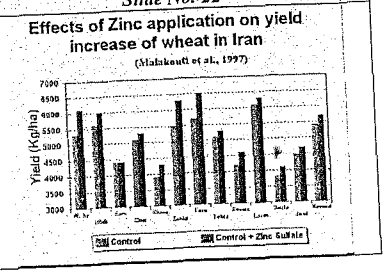

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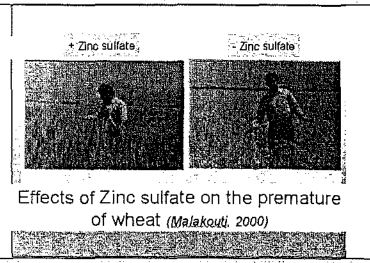

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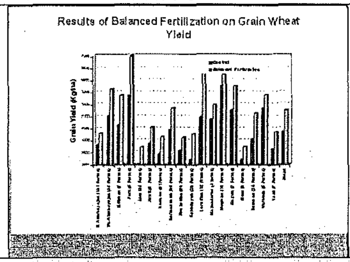

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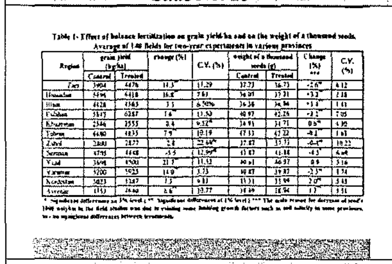

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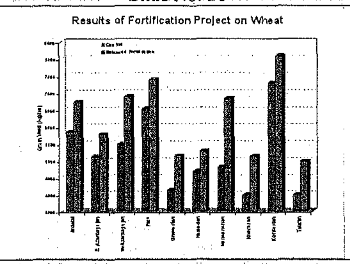

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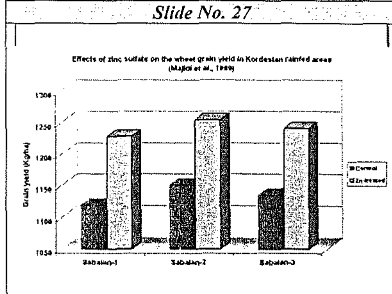

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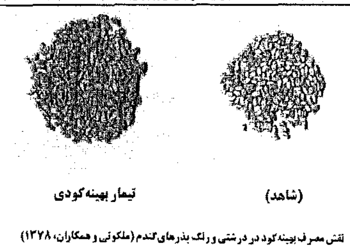

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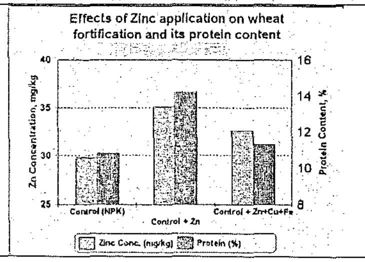

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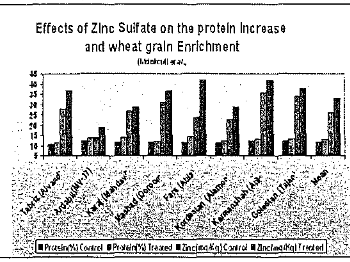

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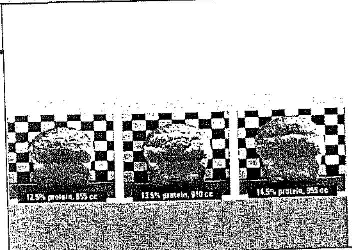

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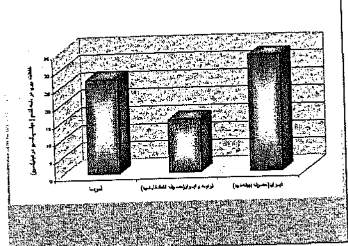

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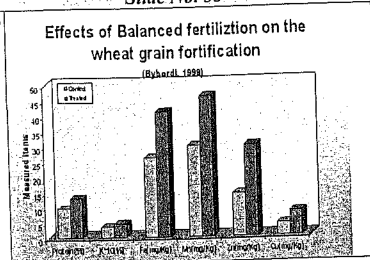

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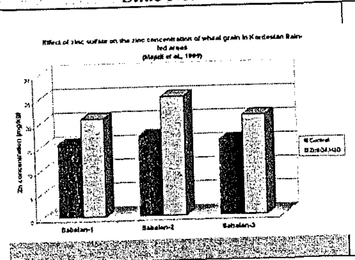

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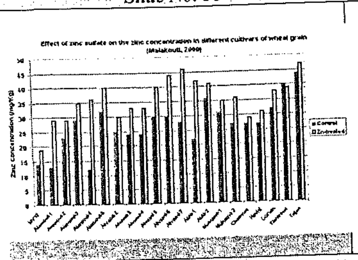


Slide No. 36

WHO (1996) Reported that PA/Zn molar ratio in foods should be lower than 25.

Gibson (1998) reported that:

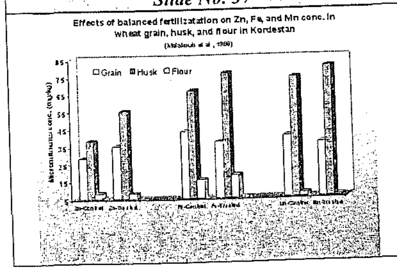
a) If PA/Zn molar ratio is less than 5, 55 percent of the minerals such as zinc will be absorbable.

b) If PA/Zn molar ratio is 5-15, only 35 percent of the minerals such as zinc will be absorbable.

c) If PA/Zn molar ratio is 15-25, less than 15 percent of the minerals, such as zinc will be absorbable.

d) If PA/Zn molar ratio is more than 25, no minerals will be absorbable in the human body.

Slide No. 37



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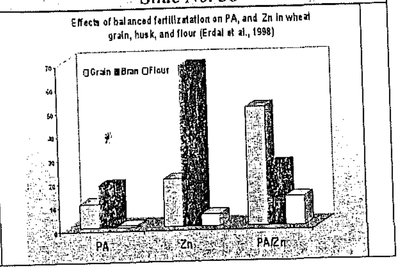

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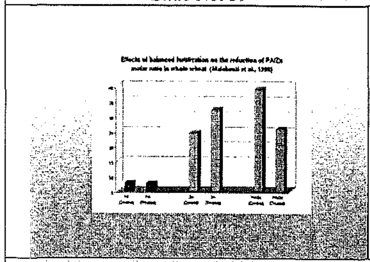

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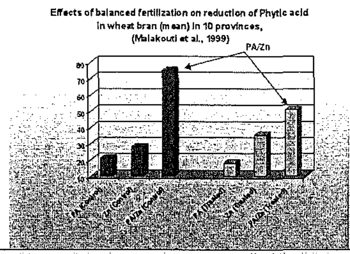

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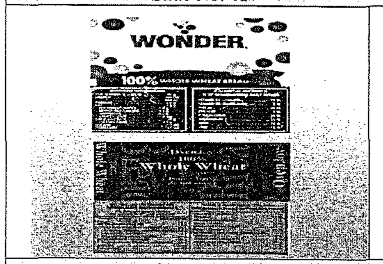

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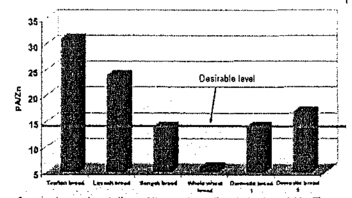


Comparison of variation of the molar ratio of phytic acid to Zinc (PA/Zn) in different local and foreign breads (Malakouti et al, 2003)

Slide No. 43

Slide No. 44

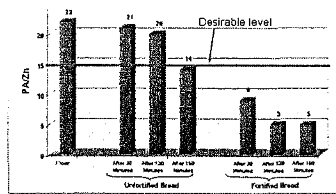
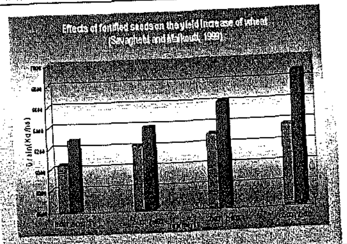


Figure-1. Role of fortification, use of sour dough, and lengthening fermentation time in upgrading the quality of breads (Malakouti et al., 2003)

Slide No. 45

Slide No. 46

Slide No. 47



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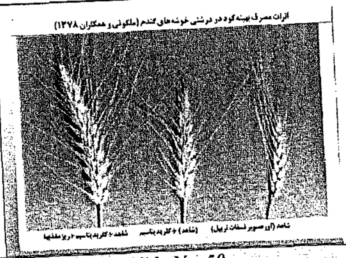
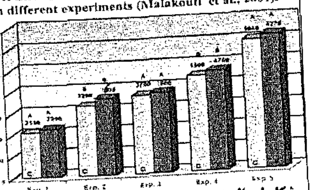


Slide No. 49

Fig. 1. Effects of zinc-fortified seeds on the wheat grain yield in different experiments (Malakouti et al., 2001).



شکل ۱– اثر غنی سازی بذرهای گندم با روی در افزایش عملکرد در آزمایشهای مختلف (ملکوتی و همکاران، ۲۰۰۱).

Slide No. 50

Table 2- The effects of seed enrichment and Zn application on the grain yields (kg/ha) under field conditions (Savaghebi et al., 2001)*

Zn / Seed	0	5	10	20	Average
Normal seed	6046 G	6214 F	6303 DE	6365 DC	6233 B
Enriched	6276 EF	6390 C	6611 B	6483 A	6540 A
Average	6162 D	6304 C	6457 B	6624 A	6359
LSD 1%	Zn x seed=63.06	Zn=64	Seed=32.53		

* Grouping of the averages were done separately for Zn levels, seed, and seed x Zn

Slide No. 51

Table 3- The effects of seed enrichment and Zn application on the Zn level of straw under field conditions,* (mg/kg) (Savaghebi et al., 2001)

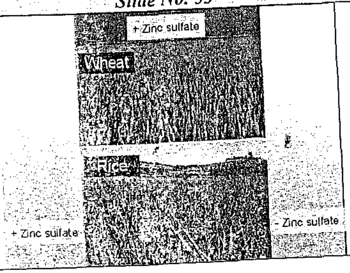
Zn / Seed	0	5	10	20	Average
Normal seed	15.40 H	21.81 F	28.75 D	30.57 C	24.18 B
Enriched	16.71 G	26.55 E	31.41 B	32.86 A	26.93 A
Average	16.05 D	23.68 C	30.18 B	31.71 A	25.56
LSD 1%	Zn x seed=0.455	Zn=0.492	Seed=1.345		

*Grouping of averages was done separately for Zn levels, seed treatments, and seeds x Zn.

Slide No. 52

Effects of Zinc sulfate on the quality of potato (Malakouti and Bybordi, 2003)

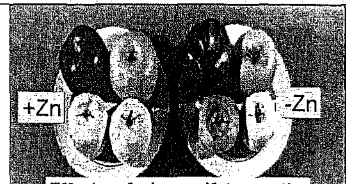
Slide No. 53



Slide No. 54

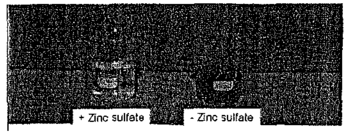
Effects of Zinc sulfate on the premature of canola (Salimpour et al., 2001)

Slide No. 55



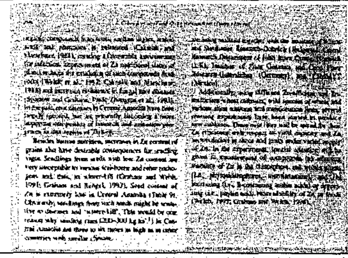
Effects of zinc sulfate on the discoloration of the apple juice due to formation of antioxidants (Souri and Malakouti, 2000)

Slide No. 56



Effects of zinc sulfate on the discoloration of the apple juice due to formation of antioxidants (Souri and Malakouti, 2000)

Slide No. 57



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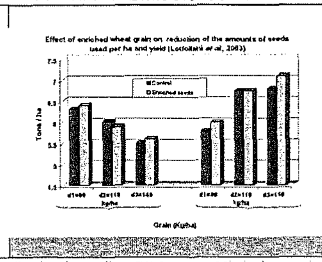
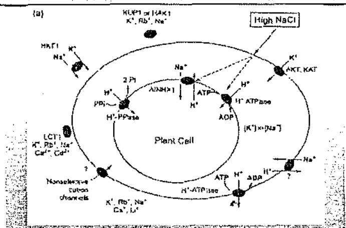


Slide No. 59

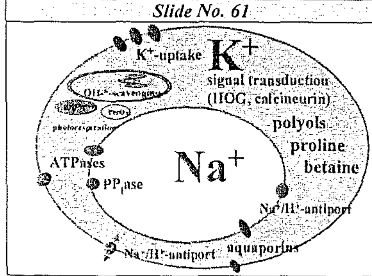
Salinity induce structural changes in stem, root and leaf tissues; few xylem vessels with smaller size were noticed in stressed plants. The higher concentration of Zn improved growth especially in roots and enhanced xylem formation in comparison to stressed plants grown at the same osmotic potential without Zinc (Gadallah and Ramadan, 1997).

Slide No. 60



(Schachtman and Liu, 1999)

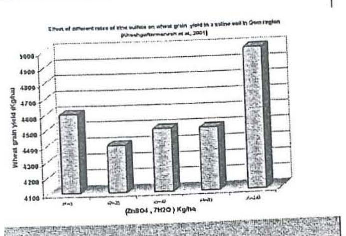
Slide No. 61



Slide No. 62

Cross-sections through stems of safflower plants (showing the vascular cylinder) growing in saline solutions having different osmotic potentials in MPa: 0 (A), -0.3 (B), -0.6 (C), -0.9 (D); in the absence of (I) and presence of 10 (II) and 20 mg dm-3 Zn (III) (Ghadallah and Ramadan, 1997)

Slide No. 63



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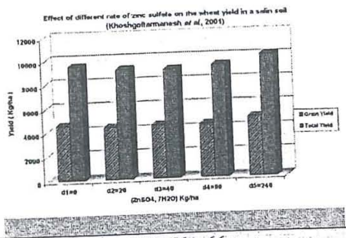

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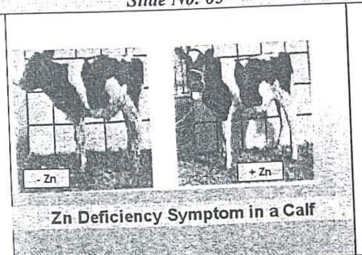

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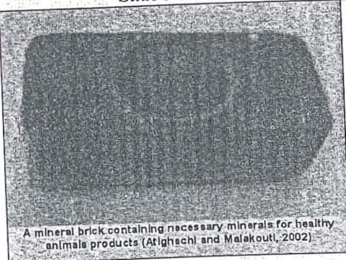

Slide No. 67

Table I Zinc intake and percent of zinc deficiency in different continents (Woehler et al., 2000)*

Region / Zinc intake	Western Europe	North America	Eastern Europe	Western Pacific	China	Western Asia	Southern Africa	North Africa	South Asia	World Average
mg/Zn/day	3.2	2.9	2.1	2.0	1.5	1.1	1.0	1.0	0.8	1.5
%deficient	0.8	0.9	12.8	18.6	21.4	71.2	68.0	73.5	94.4	48.9

* The author believes that in the Middle East countries percentage of zinc deficiency is similar to South Asia

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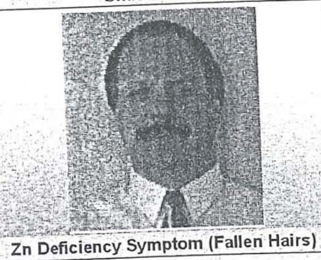

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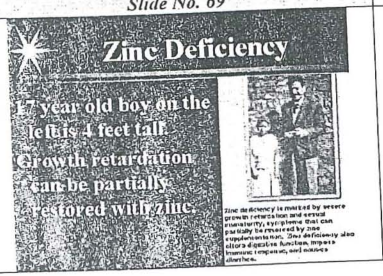

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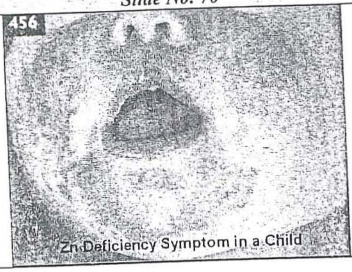

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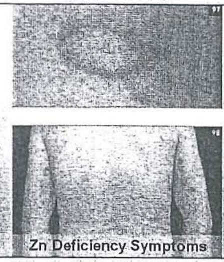

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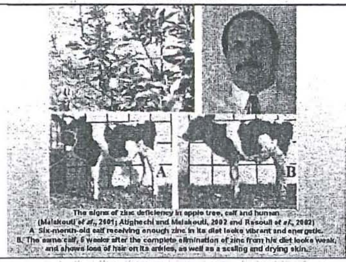

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Slide No. 74

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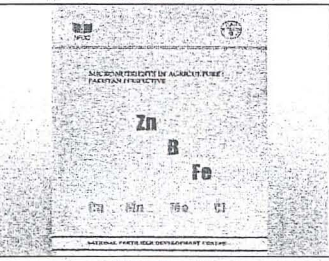

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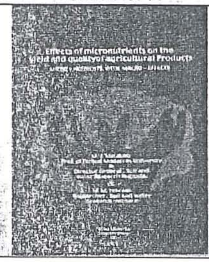

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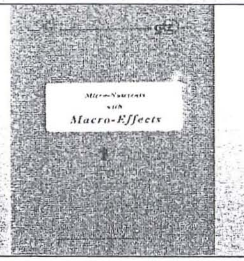

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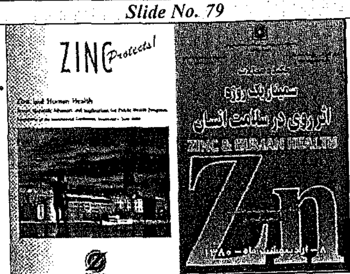

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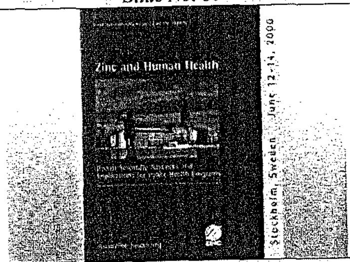

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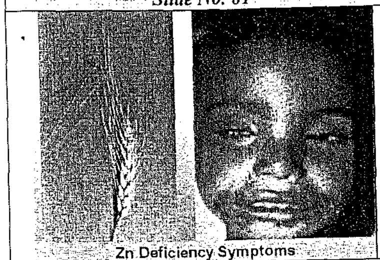

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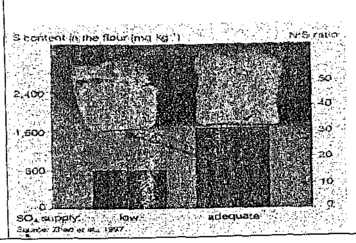

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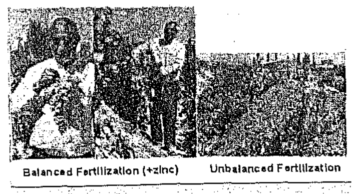

CONCLUSIONS

Soils are dynamic living systems whose physiochemical properties determine the level of production of food and fiber and the universal ecosystem equilibrium. Soil quality, soil health and a sustainable agriculture will determine the quality of our environment and consequently, the health of plant, animal and human. Therefore, soil health will improve with proper management and practical decisions that encompass various phases of the soil system, but it is bound to deteriorate when a series of one dimensional management practices such as crop production goals alone are considered.

Calcareous soils which are dominant in Middle East countries have high pH (7.5-8.1) and low organic matter contents (less than 1%) and, therefore, the crops would contain lower than average levels of zinc. Too little rain also adds to zinc deficiency problem in these regions. It has been reported that 99% of zinc added to soils as fertilizers is combined with soil components, especially with $CaCO_3$. DTPA extractable zinc in the soils is often less than 1.00 mg/kg whereas under favorable conditions it should exceed 1.00 mg/kg. The plants that are grown in such soils suffer from zinc deficiency, which is why the concentrations of micronutrients especially zinc are below critical level in more than 80% of the crop products grown in the calcareous soils. Most of the people who consume such crop products suffer from anemia. A balanced application of plant nutrients, especially zinc sulfate, at rates determined experimentally not only improves the crop yields but also their quality with respect to the concentration of zinc and other essential micronutrients. Zinc deficiency is a critical nutritional problem for plants, animals and humans in the calcareous soils. Field, greenhouse and growth chamber experiments were carried out to study cereal species and within cultivars of wheat. Among the cereals, oat had particularly high Zn efficiency. High Zn efficiency cultivars were closely associated with enhanced capacity of some lines to take up Zn from soils, not with increased Zn accumulation per unit dry weight of shoot or grain. Measurement of Zn-containing superoxide dismutase activity in leaves revealed that an efficient utilization of Zn at the tissue or cellular level is an additional major factor involved in Zn efficiency of cereals. Zinc present in grains seems to be not bioavailable. Phytate: Zn molar ratios in grains, a widely accepted predictor of Zn bioavailability, were high for crops grown on Zn-deficient soils. In the studies concerning determination of Zn nutritional status of school children, most children were found to be of shorter stature and had very low levels of Zn.

Among the micronutrients, zinc deficiency is seen to be most widespread in agricultural products worldwide, especially in arid and semiarid regions with sandy soils and high pH. Another factor in causing zinc deficiency in foods would be due to overuse of P-fertilizers that hinder zinc absorption by plant roots. Different crop varieties also have different potentials in absorbing zinc from deficient soils. Some cations also decrease the rate of zinc absorption by roots. As pointed out before, the absorption of zinc into the body not only depends on the rate of zinc intake but also on the level of other chemicals like phytic acid that can hinder its absorption. The role of microelements in the making and maintenance of a balanced physiology in plants, animals and humans is becoming more and more clear everyday from the studies on their reactions and the disturbances that result form their deficiencies. Zinc is one of those essential microelements and even though it is present in small amounts in the body, it activates some 100 enzymes in humans, domestic animals and various plants. It is sufficient to say that we would not be able to survive without zinc because it is essential in synthesizing DNA and RNA and in metabolizing carbohydrates, fats, proteins and alcohols and in the release of carbon dioxide, in optimizing the function of vitamin A and the immune system. The body's requirement for zinc (RDA) varies with age, sex, weight, metabolic functioning, heredity factors, pregnancy and breastfeeding. The minimum daily requirement would be 15 mg. An intake of 150 mg/day for long periods would cause toxicity symptoms. The deficiency symptoms include short size down to midget heights, hepatosplenomegaly, geophagia, anemia, persisting wounds, increased levels of allergy symptoms, infections, slow healing skin injuries, dry and rough skin, and a reduced level of immune system functions. Boys show zinc deficiency symptoms more frequently than girls. Zinc deficiency in pregnant women causes miscarriage, low birth weights, and premature delivery, injuries to the nervous system, and birth defects. Investigations show that more than 48% of human population suffers from zinc deficiency all over the world. This deficiency is often associated with iron and vitamin A deficiencies. Among the various regions in the world, Western Europe and North America with the highest rate of zinc intake suffer the lowest deficiency rate of less than 1%. South Asia and Middle East countries, on the other hand, show the lowest rate of zinc intake and, therefore, the highest rate of this deficiency affecting more than 95% of the population. Currently, one out of every four rural children and one out of every five children in the urban areas show short heights, which is in principal related to zinc deficiency. Recently, it was in the media that Iranian youngsters' height had been reduced 5cm mainly due to malnutrition.

Soil or foliar applications of Zn to correct deficiencies in edible parts of plants are, however, effective only for a short time, and must be carried out either every year or every 2 to 3 years. Improvement of Zn nutritional status of plants is also very beneficial with respect to disease resistance and seedling vigour. Zinc-deficient plants are sensitive to pathogenic fungal root diseases. Zinc availability is quite low in foods that contain high levels of phytic acid or fiber. These compounds strongly combine with zinc and prevent its absorption into the body or into the animal metabolic systems. Cereals or cereal foods are rich in substances like phytic acid and fiber and therefore, high rates of consumption of such foods would lead to zinc deficiency symptoms. Especially in children and breast feeding mothers. Results from calcareous soils reveal that the concentrations of phytic acid in wheat grain is affected by the level of zinc applications, while no such effect would be seen if the plants were to be raised under zinc deficient conditions. The high levels of phytic acid in zinc deficient wheat grain could be related to high levels of phosphorus absorption under such conditions followed by high rates of translocation of the phosphorus to the branches. Therefore, the molar ration of phytic acid to zinc (PA/Zn) should be studied as a factor in determining the level of availability of zinc and in predicting the dangers of its deficiency levels. Usually, a ration of PA/Zn that exceeds 15 would result in zinc deficiency problems, especially in children.

Zinc deficiency as a cause of infertility in men has been the focus of a lot of attention whereby the related problems of many men seem to be solved with zinc supplements. This is because, according to many specialists, zinc plays a major role in the reproductive systems, the formation and maturation of sperms, ova and in the process of fertilization. Zinc is second only to iron in terms of quantity in the body. It activates more than 100 enzymes in plants, animals and humans. The role of zinc in human health is quite well established; this element can be found in the teeth, prostate, muscles and so on. Some 48% of the world population suffers from anemia, which is caused by iron and zinc deficiencies. The rate of zinc deficiency in Iran is higher than the world average because unbrand flour is used for bread which is the people's main staple food. In Iran some 70% of the protein is obtained with bread prepared from unbrand flour for its low levels of phytates. Therefore, the bread prepared in this way only provides us with the calories and protein. Zinc intake will play an important role in controlling colds, glaucoma, rheumatoid arthritis, asthma, diabetes, malfunction of glands, especially the thyroid, Alzheimer's, menstrual discharges, premenstrual syndrome, hemorrhoids, bad breath, bladder infection, infertility, muscle aches, injuries from various kinds of burns, nervous stresses, etc. Zinc is also effective in reducing the severity and the duration of colds, and it acts as an antibacterial and antifungal material and can be used as an antiseptic for mouth and nose. Zinc participates in the physiological processes of the reproductive, nervous, immune, and digestive systems and skin protective action; so its deficiency will be noticed in various parts of the body.

In general, zinc acts as a cofactor of various enzymes in producing its effects. Consequently, zinc would be essential for a healthy appetite, gustatory and olfactory senses, skin protective action, proper body posture, mental activity and the natural immune system functioning as well as for curing wounds. Zinc is one of the components of the teeth enamel. This element, much like iron, protects the body from heavy metal toxicities. Wherever sufficient levels of zinc, iron and calcium are present, lead toxicity symptoms will not develop in children...Investigations on the zinc status of some child bearing women ion America who had premature deliveries showed that they suffered from zinc deficiencies. Zinc deficiency was shown to be associated with low birth weights at twice the normal rate and premature births at three times the normal rate as well as with the reduced rates of fetus growth. These various effects are carried out through the metabolic activities of hormones such as androgen, estrogen, progesterone along with prostaglandins.

For various reasons mentioned above, there is an urgent need for improvement of Zn nutritional status of humans and plants in calcareous soils, including the Middle East countries. Most cereal farmers and many research institutions were not aware of the Zn deficiency problem in cereals until the early 1990s. The application of Zn fertilizers to cereals was carried out in calcareous soils. The area was cropped with cereals, with average wheat yields near 2250 kg/ha. If we assume that only 50% of the cereal growing areas have Zn deficiency, and Zn application results in only 25% increase in yield, then, an increase of millions of dollars per year in wheat production by Zn application is possible, which is equivalent to a benefit of the residual effects of applied Zn for 2 to 3 years.

The most effective method of zinc application for improving wheat yield and increasing the concentration of zinc in grain would be the soil application of $ZnSO_4.7H_2O$ plus the foliar application of zinc sulfate solutions. The rates of zinc application would have to be determined experimentally since they vary with different soils and growing conditions. Other methods of zinc application include soil application by itself, soaking the seeds in zinc sulfate solutions, foliar application alone; and foliar application plus seed treatment. Zinc fertilization in zinc deficient soils has been shown to improve the yields of cereal crops and beans and also the zinc levels in the resulting grains, including wheat.

Seafood, especially oyster, shrimp, fish, red meat and eggs are rich sources of zinc. Among the plant foods, pumpkin seeds and squashes are rich in zinc, but unfortunately the bread is quite poor in zinc because of the fact that the wheat bran is discarded and that unscientific ways are used in the conversion of flour to bread. Smoking and drinking tea immediately after taking meals should be avoided because zinc does not get absorbed in digestive system in the presence of nicotine, theine and phytic acid. Addicts are cautioned against the use of opium as it is also severely interferes with the absorption of zinc in the digestive system. The author himself has not had a cold or loss of a single hair during the past 7 years since he began taking 2 capsules (50 mg Zn) of zinc sulfate per week with meal, even though, he used to have frequent colds, felt tired easily and used to lose hair before he began to take zinc supplements. As a result of the authors' persistence in advocating zinc supplements, more than 20 million capsules of zinc sulfate are being taken every year in Iran as compared with 2 million capsules before 1997. However, a more logical approach would be to enrich the crops, forages and pastures that are produced in calcareous soils with zinc so that everyone gets the required amount of these essential nutrients in their diets. Finally, our aim should be to improve the yield as well as the quality of agricultural and animal products with respect to micronutrients starting at the fields and pastures, ending up at the consumers' tables so as to promote human health.

UNICEF INTERVENTIONS IN MICRO-NUTRIENTS DEFICIENCY IN SYRIA

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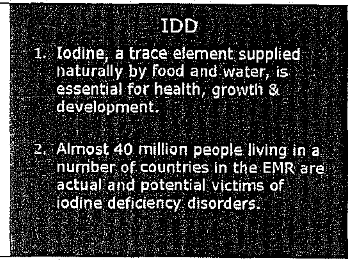

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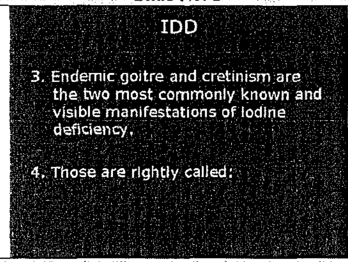

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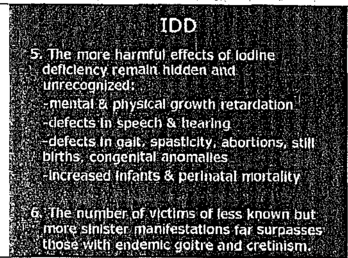

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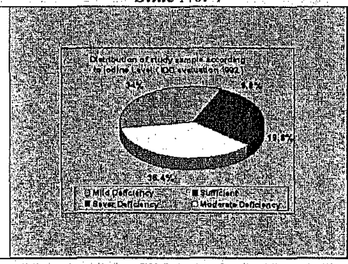

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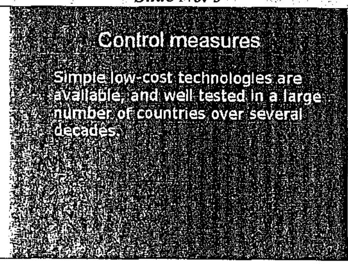

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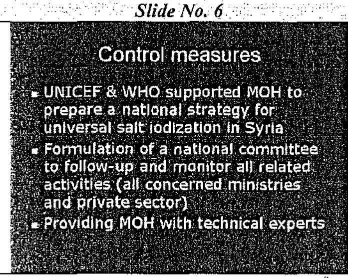

E. Bahnasi: UNICEF Representative, Damascus Office

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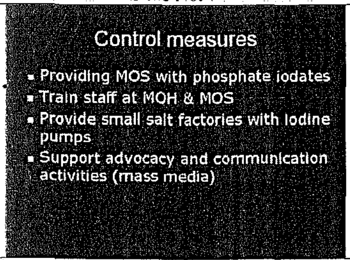

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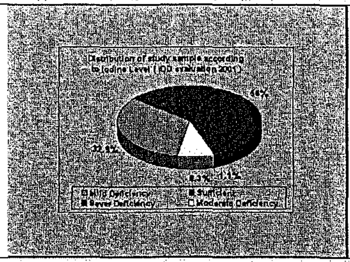

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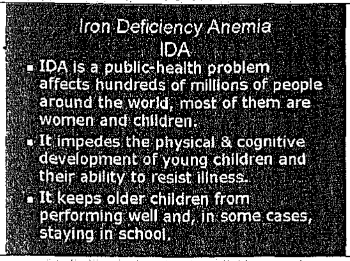

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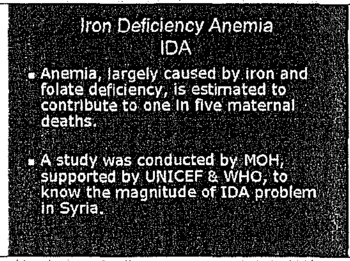

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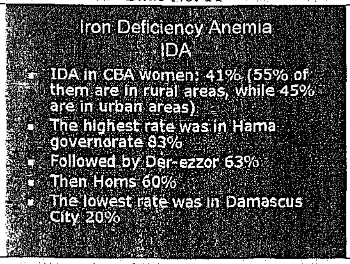

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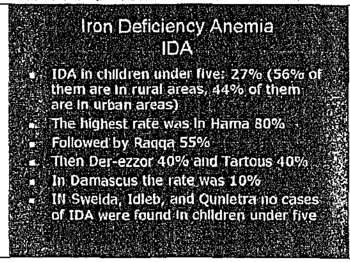

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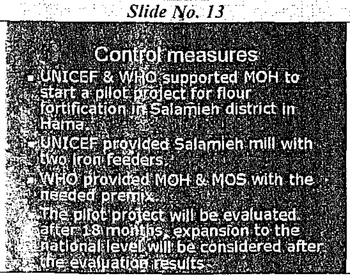

MICRONUTRIENTS DEFICIENCIES AND THEIR IMPACT ON HUMAN NUTRITION & HEALTH

1. INTRODUCTION

Most developing countries are suffering from several nutritional problems. These problems are hampering the development programs for these countries due to the complications of these problems on health and activity. The Government of Egypt has outlined a comprehensive set of food and nutrition policies and strategies. An inter-ministerial committee, chaired within the Ministry of Agriculture, has prepared a draft for a National Nutrition Plan of Action.

Malnutrition is usually the result of a combination of inadequate, or unbalanced dietary intake and infection as mentioned earlier. In children, malnutrition is connected with growth failure. Micronutrients are needed for the production of enzymes, hormones and other substances that are required to regulate biological processes leading to growth, activity, development and the function of the immune and reproductive systems (Díaz-Gómez et al 2003). While micronutrients are needed at all ages, the effects of inadequate intake are particularly serious during periods of rapid growth, pregnancy, early childhood, and lactation (Omran and Salem 2002).

Good nutrition helps to prevent acute and chronic illness, to develop physical and mental potential, and to provide reserves for stress (Annibale et al 2001).

Although any diet producing good nutrition varies considerably, mild excesses of nutrients or calories may be as undesirable as mild deficiencies. So the first purpose of any nutritionist is to uncover all the nutritional problems of his community. This is done through the nutritional surveys together with the biochemical analysis of a representative sample of the community (Kohli-Kumar 2001).

Any nutritional deficiency is either due to decreased intake or to decreased bioavailability or to both of them. The most reliable methodology would be studying the food consumption pattern of these communities and these results should be correlated with the results of their nutritional status.

The metabolism and impact of these deficient micronutrients should be thoroughly understood so that the nutritionist can prescribe the needed studies and intervention programs according to the nutritional status and the food consumption results.

Therefore, to have such comprehensive view of the nutritional problems in Egypt, this paper would cover several items:

1) Micronutrients deficiencies and Nutritional status in Egypt
2) The food consumption pattern of micronutrients in Egypt
3) The metabolism, deficiencies and impact of some important micronutrient deficiencies, iron and zinc
4) Intervention programs performed in Egypt
5) Future steps that can be undertaken in Egypt

M. El-Guindi: MD. Prof. of Pediatrics and Nutrition, National Liver Institute, Menoufiya University, Cairo, Egypt.

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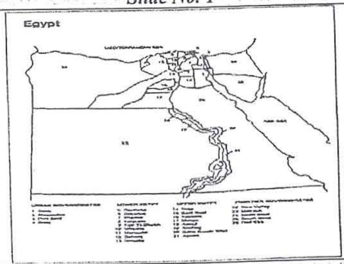

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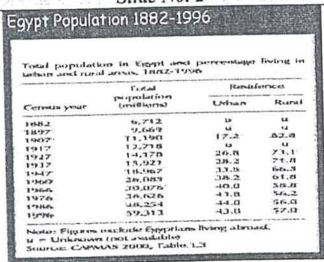

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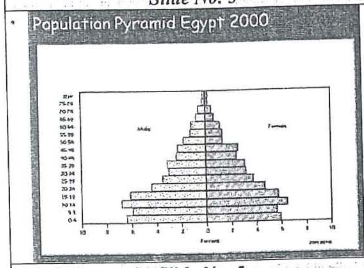

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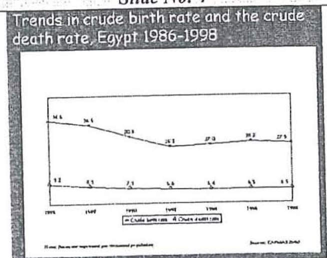

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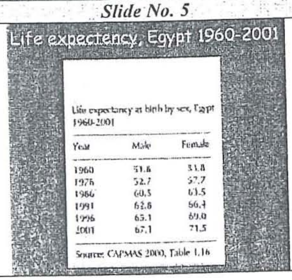

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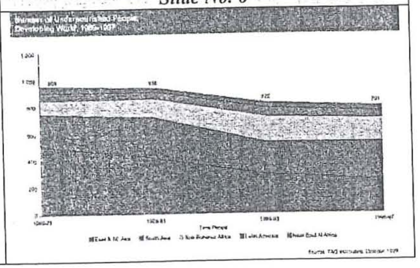

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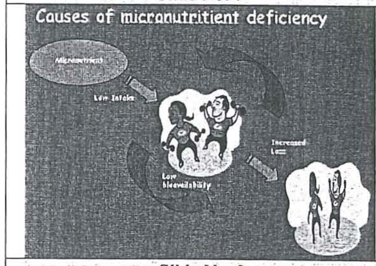

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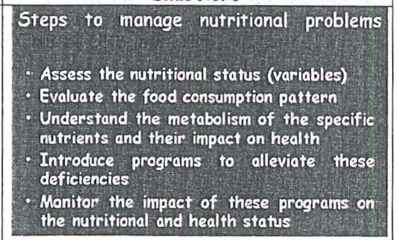

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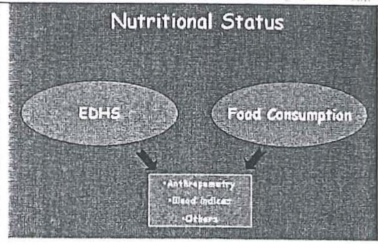

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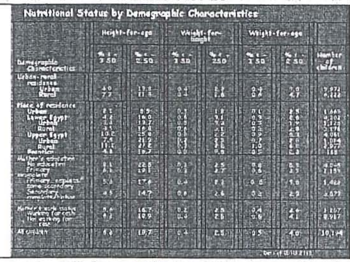

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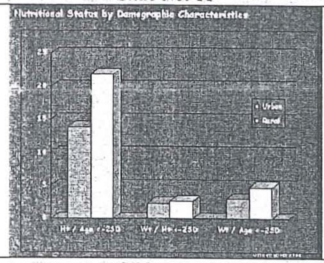

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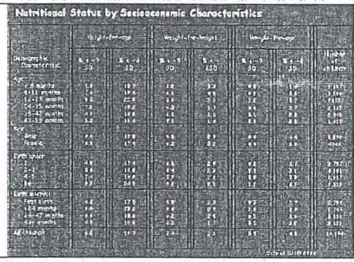

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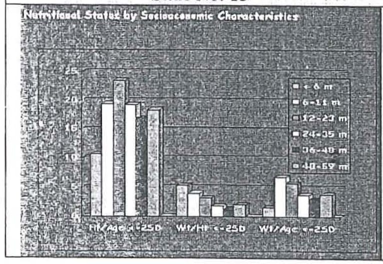

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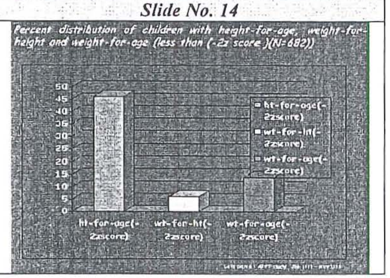

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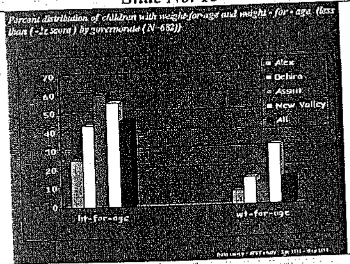

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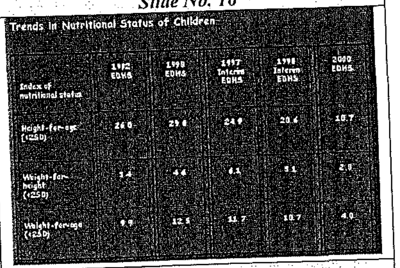

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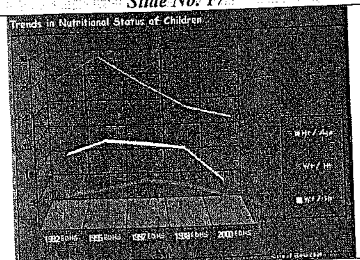

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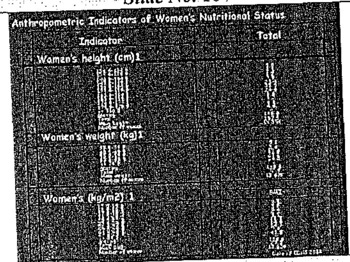

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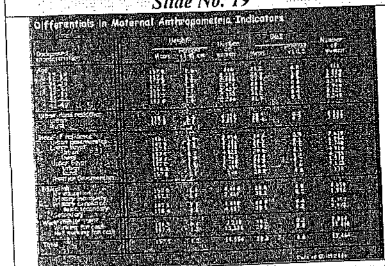

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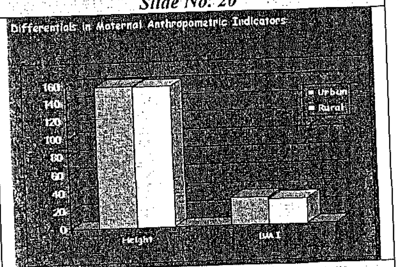

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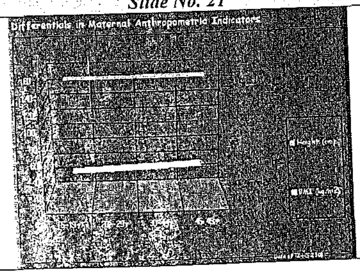

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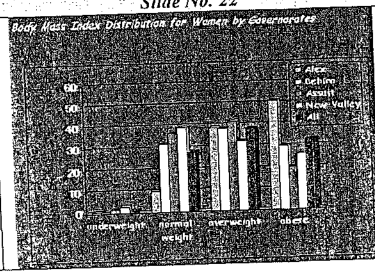

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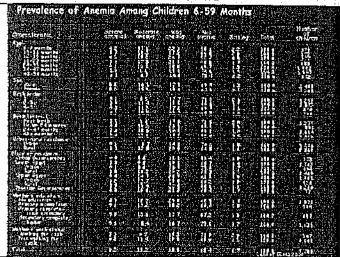

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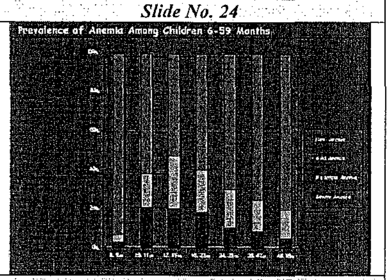

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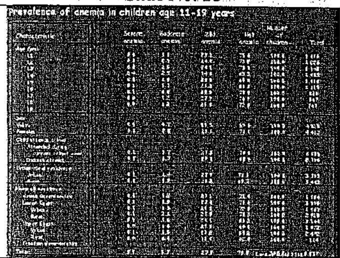

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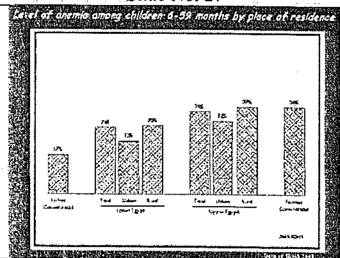

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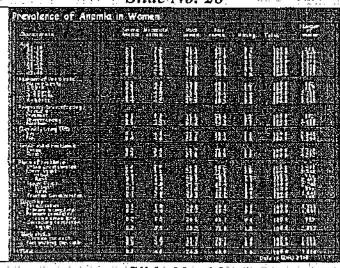

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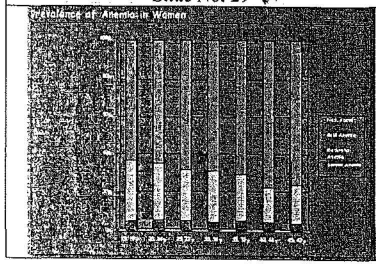

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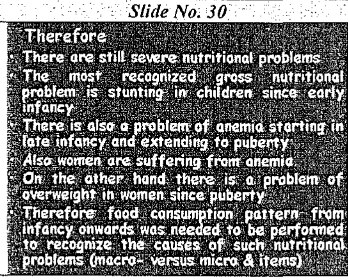

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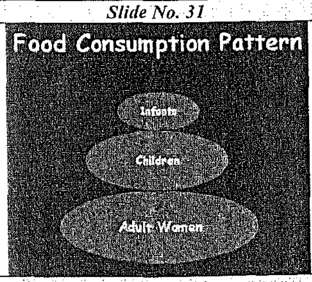

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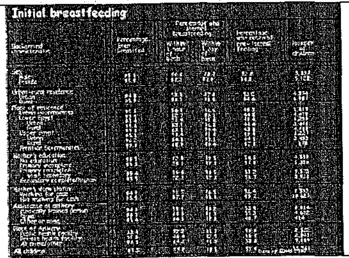

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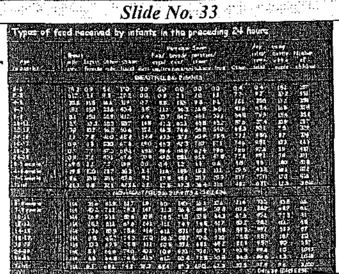

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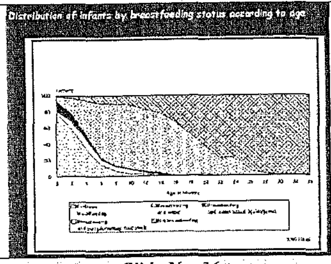

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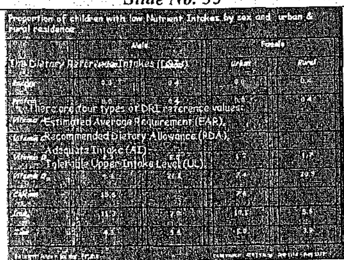

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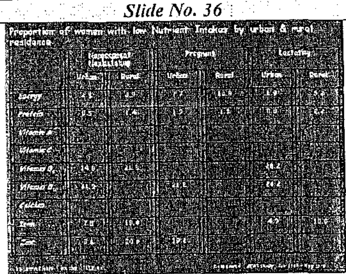

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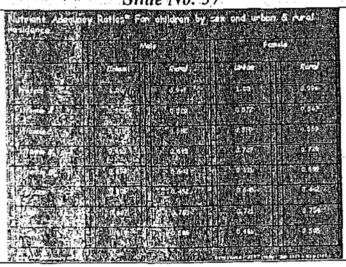

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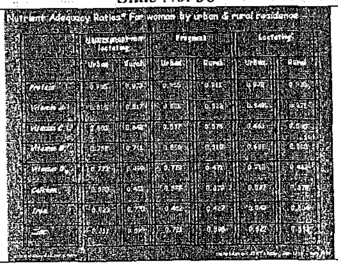

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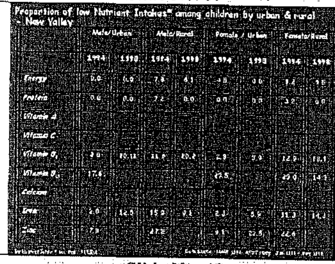

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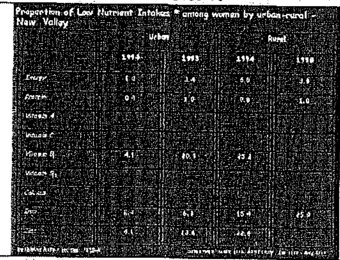

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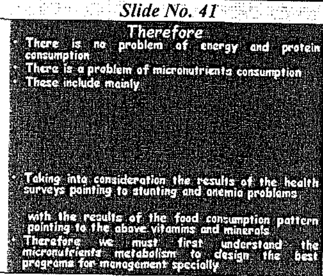
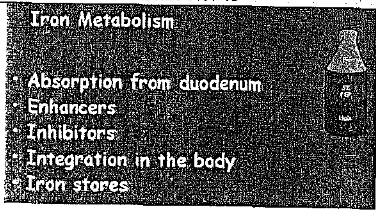


Slide No. 42

Micronutrients metabolism & their impact on human health

Slide No. 43

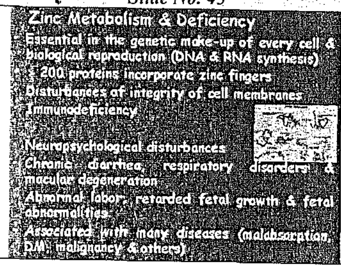


Slide No. 44

Iron Deficiency

- Pregnancy:
  - Shorter pregnancies
  - ↑ Maternal mortality
  - ↑ Fetal mortality
  - ↑ Low birth weight infants
- Infancy & childhood:
  - Functional intestinal alterations
  - Impaired exercise capacity
  - Alterations of behavior
  - Alterations in cognitive performance

Slide No. 45



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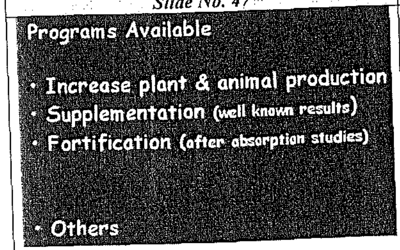
Programs Implementation

Slide No. 47



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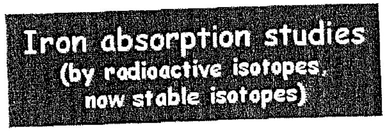

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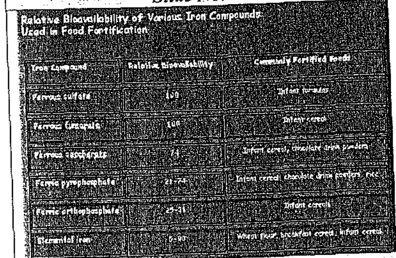
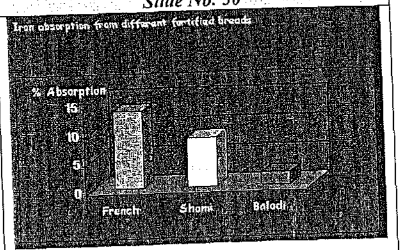


Iron Compound	Relative Bioavailability	Commonly Fortified Foods
Ferrous sulfate	100	Infant formulas
Ferrous fumarate	100	Infant cereal
Ferrous saccharate	74	Infant cereal, chocolate drink powders
Ferric pyrophosphate	21-74	Infant cereal, chocolate drink powders, rice
Ferric orthophosphate	25-32	Infant cereals
Elemental iron	5-90	Wheat flour, breakfast cereal, infant cereal

Slide No. 50



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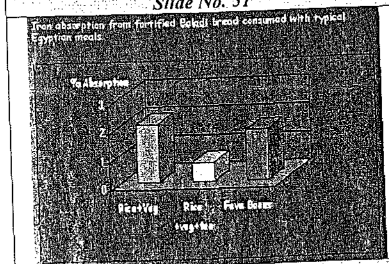

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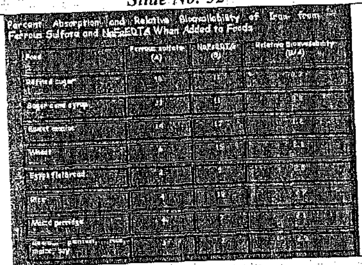

Food	Ferrous sulfate (A)	NaFeEDTA (B)	Relative Bioavailability (B/A)
Refined sugar	[illegible]	[illegible]	[illegible]
Sugar cane syrup	[illegible]	[illegible]	[illegible]
Sweet maize	14	[illegible]	[illegible]
Wheat	[illegible]	[illegible]	[illegible]
Egypt flatbread	[illegible]	[illegible]	[illegible]
Rice	[illegible]	[illegible]	[illegible]
Maize porridge	[illegible]	[illegible]	[illegible]
[illegible] maize [illegible]	[illegible]	[illegible]	[illegible]

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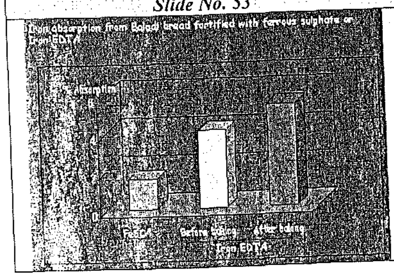

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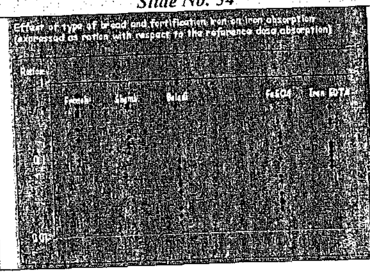

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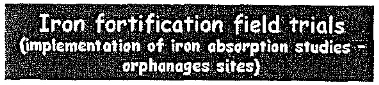

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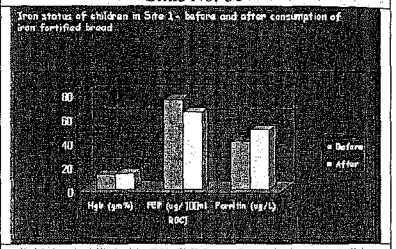

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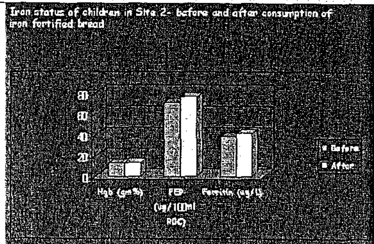

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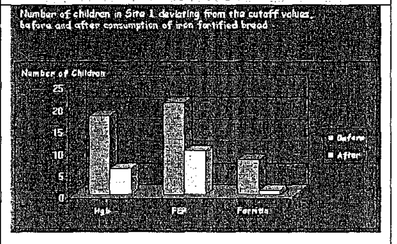

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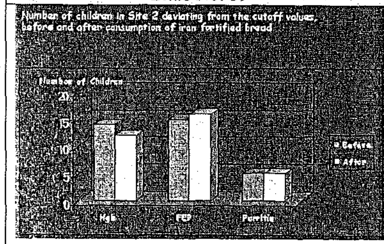

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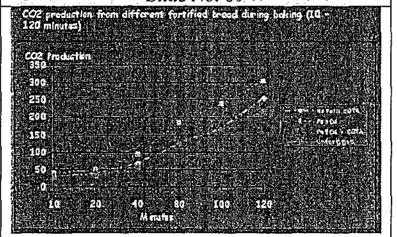

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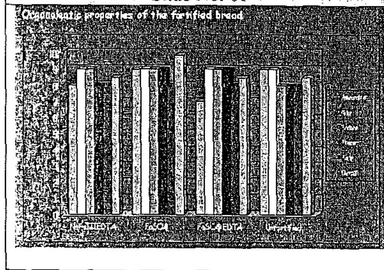

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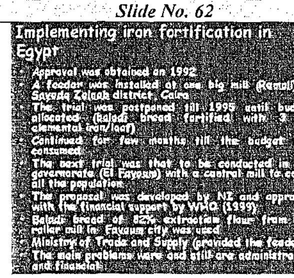


Slide No. 63

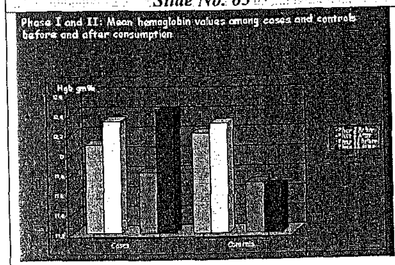
Other fortification experiences in Egypt

- Iron fortified school lunch biscuits (90 days/yr)
- Iron and lysine fortified macaroni
- Iron fortified infant milk formula and complementary foods

Slide No. 64

Other food based approaches (increase enhancers)

Slide No. 65



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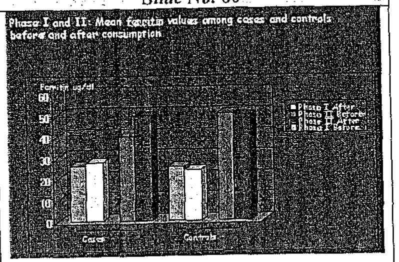

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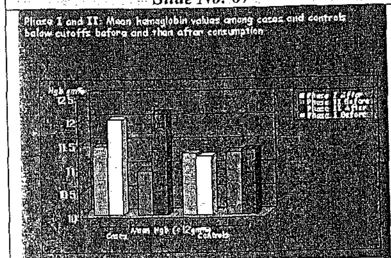

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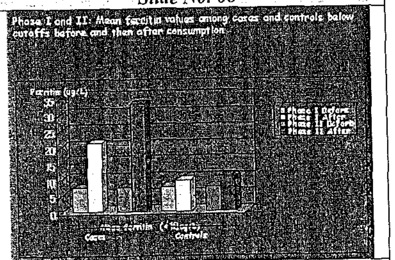

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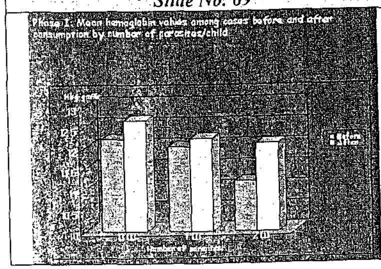

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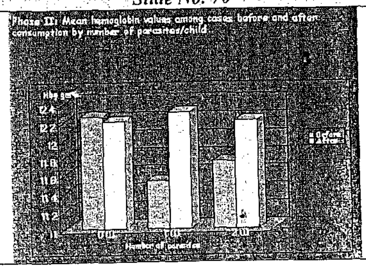

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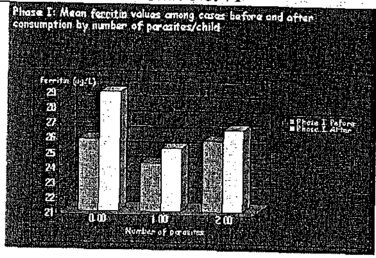

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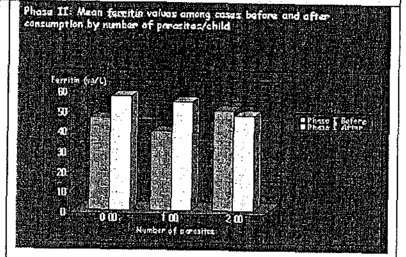


Slide No. 73

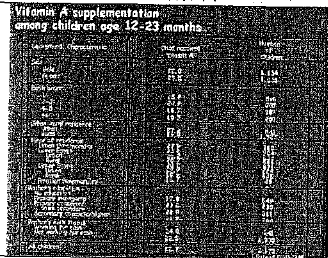
Other micronutrients

Vitamin A: Egypt has a program of Vitamin A supplementation for new mothers and for children beginning at age of nine months

- New mothers: Vitamin A capsule is given within the first two months after delivery
- Children:
  - At 9 months: A capsule (100,000 IU) is given
  - At 18 months: Two capsules (200,000 IU) is given

Iodine: Egypt has adopted a program of fortifying salt with iodine to prevent iodine deficiency

Slide No. 74



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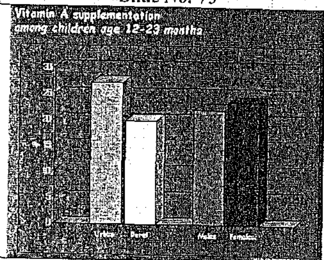

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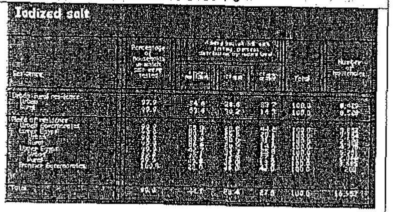

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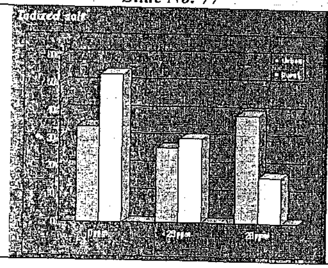
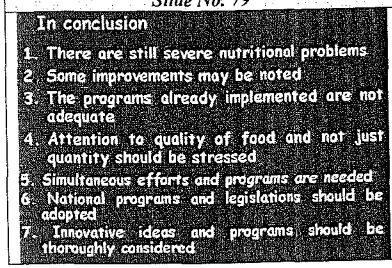


Slide No. 78

Nutritional & health education

Slide No. 79



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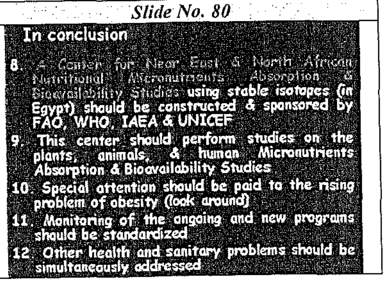


2. SUGGESTED FUTURE APPROACHES

2.1 Objectives

Perform several micronutrient bioavailability studies using stable isotopes to evaluate iron absorption after iron fortification and food based interventions. The results of these studies would evolve in a national comprehensive strategy to combat micronutrients deficiency specially iron deficiency and iron deficiency anaemia.

a) Study absorption and metabolism (bioavailability) of micronutrients following fortified food in a dietary modification program for target populations (children: healthy and diseased).
b) Study the relative absorption efficiency of combinations of Fe and Zn when iron is used as a fortificant, with special reference to evaluate beneficial and disadvantageous nutrient interactions, including Fe toxicity in special disease states as in case of children suffering from thallasemia and liver diseases.
c) Evaluate food-based strategies as the addition of an enhancer to the ordinary meals and school lunch programs in improving multiple micronutrient malnutrition (I, Fe, Zn, Vitamin A) especially in children (healthy and diseased).
d) Study several mechanisms compensating for poor bioavailability in persons consuming habitual plant-based diets containing varied levels of phytate, and effect of dietary modifications/use of enhancers on nutrient absorption, including comparative studies of relative bioavailability of 'protected' fortificants (e.g. iron EDTA) that are resistant to dietary absorption inhibitors.

Several iron absorption studiės should be undertaken to answer as much questions as possible:

1. The first group of absorption studies: Using Egyptian flat baladi bread, iron absorption using several iron salts, elemental iron, ferrous sulfate and iron EDTA. This will help us to choose the best iron salt to fortify the Egyptian flour of 82% extraction.
2. The second group of absorption studies: Most common foods will be used in this study together with the fortified bread. In this study interaction of iron and zinc will be also addressed.
3. The third group of absorption studies: This project would study the difference in iron absorption from fortified bread and meals in normal, thallasemic and hepatic children.
4. The fourth group of absorption studies: will address the effect of using food based approach on iron absorption from fortified bread and Egyptian meals and school; lunch for healthy and diseased children.

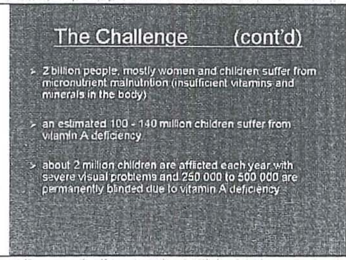
Several other strategies should be adopted:

- Calculating The Impact Of Dietary Interventions On Iron Absorption
- Predicting The Impact Of Increasing Ascorbic Acid Intake
- Predicting The Impact Of Reducing Phytate Intake
- Predicting The Effect Of Increasing Bioavailability On The Prevalence Of Inadequate Iron Intakes And Iron Status In Population Groups
- Predicting the impact Of Reducing Tea Or Coffee Consumption With Meals
- Strategies That Consider Other Micronutrients
- Multiple Strategies

FAO's Approach in Combating Micronutrient Malnutrition

Slide No. 1

Slide No. 2



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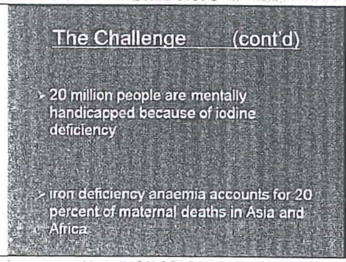

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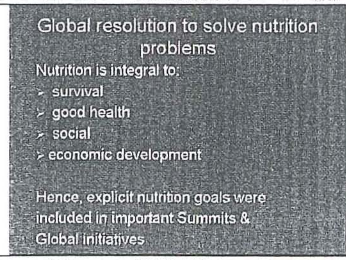

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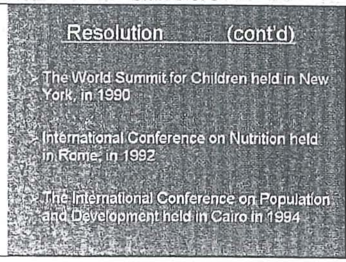

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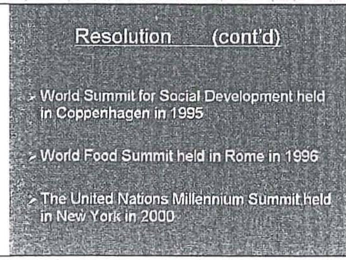

J. Aphane: Nutrition Officer, ESNA/FAO, Rome, Italy

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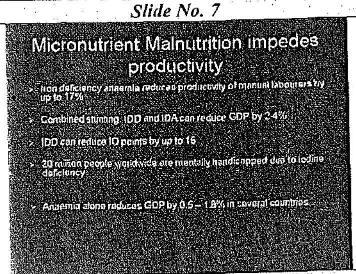

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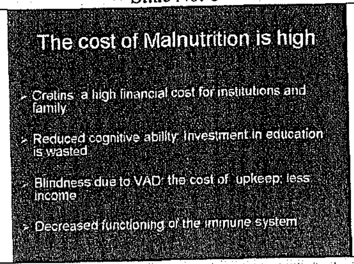

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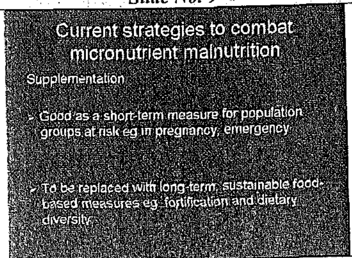

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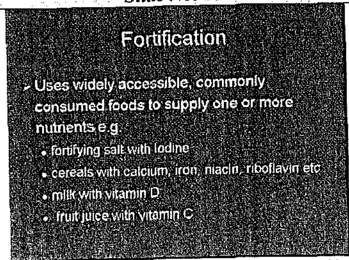

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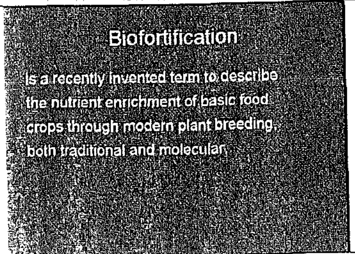

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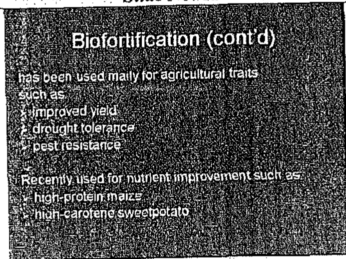

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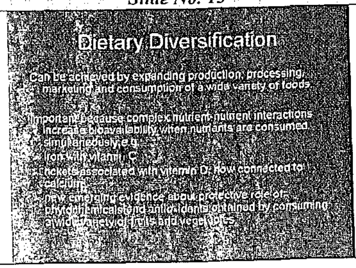

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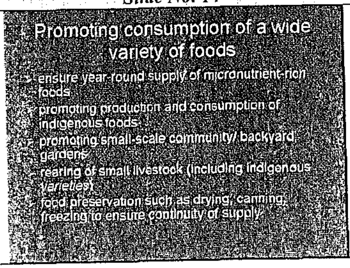

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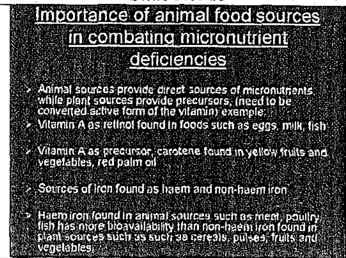

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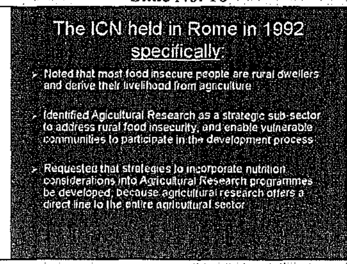

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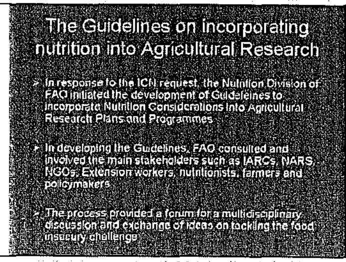

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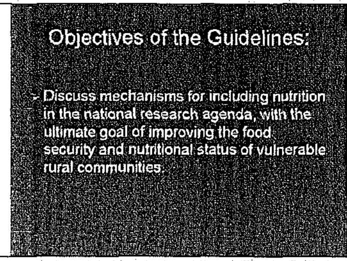

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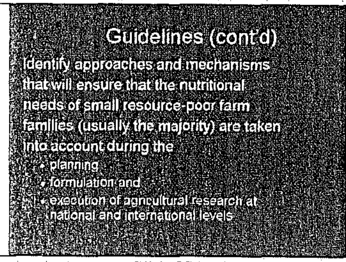

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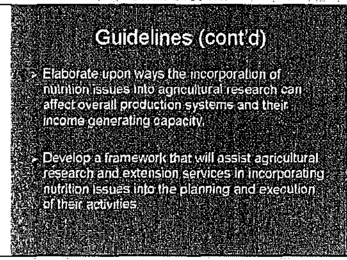

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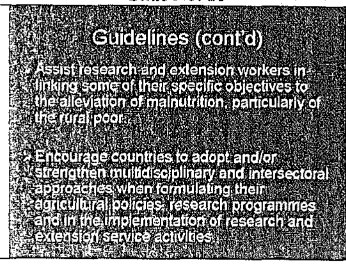

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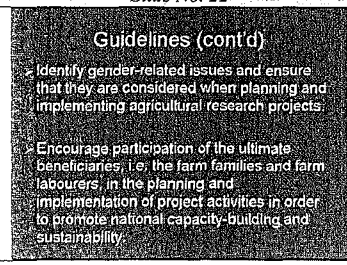

Slide No. 23

Promotion of Indigenous Foods

- Consumption of fruits, vegetables and legumes is the most sustainable way of reducing and controlling micronutrient deficiencies in resource-poor communities.
- Indiganous vegetables, besides being micronutrient-rich, have the added advantage of possessing other desirable traits

Slide No. 24

Promotion of Indigenous Foods

- *often easier to grow*
- more resistant to pests & diseases
- often more acceptable to rural and local tastes than some exotic imported varieties

Slide No. 25

Indigenous Foods (cont'd)

- In many countries, indigenous vegetables are at risk of extinction as they are being replaced by high-yielding commercial varieties.
- When an indigenous variety is lost, it can never be recovered. There is an urgent need for intervention to save this situation.

Slide No. 26

Indigenous foods (cont'd)

It is feasible to enable nutritionally vulnerable communities to obtain their Vitamins A, C and iron from indigenous vegetables for the following reasons:

- indigenous vegetables are culturally known and acceptable to local tastes;

Slide No. 27

Indigenous foods (cont'd)

- *in general, indigenous vegetable crops are rich in micro-nutrients; can enhance the bio-availability of micronutrients in other staple crops when consumed together; are normally consumed fresh, thereby providing opportunity to capture the vitamin C which is generally present in fresh foods*

Slide No. 28

Indigenous foods (cont'd)

Agronomically, indigenous vegetable crops can grow under a wide range of *environmental conditions;* and are more resistant to pests and diseases than exotic vegetable crops

Slide No. 29

Indigenous foods (cont'd)

- in many parts of the world, indigenous crops are considered to be 'women's crops' in that they are mostly grown or gathered by women.
- indigenous vegetable crops which normally grow as "weeds" during the rainy season are cultivated, this would save women the time and the back-breaking task

Slide No. 30

Indigenous Food Crops (cont'd)

There is a high potential for women to earn additional income from selling surplus indigenous crops

In many countries, a market for these foods exist

Slide No. 31

Indigenous foods (cont'd)

- The use of *traditional* vegetable crops is partly associated with cheap production methods and low level of external inputs.
- With more information on the attributes of indigenous vegetables, such as their nutritional content and anti-oxidant properties, their market value would further increase

Slide No. 32

Indigenous Food Crops (cont'd)

there is a need to train community members in producing and multiplying seed of indigenous vegetable crops, so as to maintain a continuous sustainable supply of seed for increased production across all seasons.

Slide No. 33

CONCLUSION

- A multidisciplinary intervention is *imperative* for any project / programme which aims to reduce micronutrient deficiencies in a sustainable consumer

Slide No. 34

- The Nutrition Division of FAO in collaboration with the World Vegetable Center is working with countries to design multidisciplinary projects to promote production and consumption of indigenous food crops and small animal

Nutrient Requirements of Awasi Sheep for Lactation

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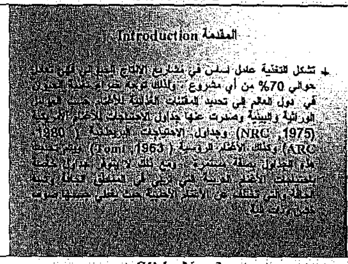

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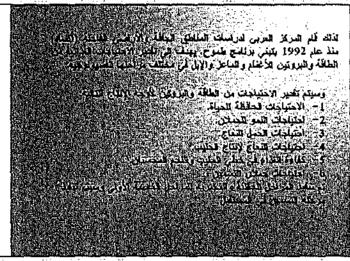

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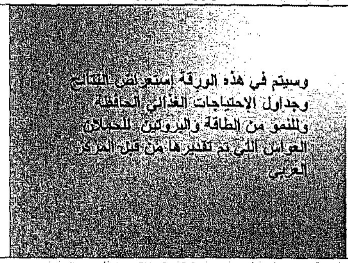

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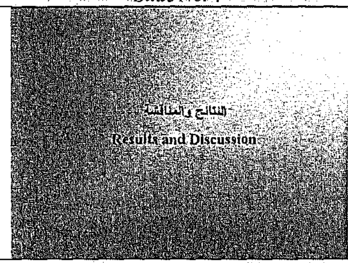

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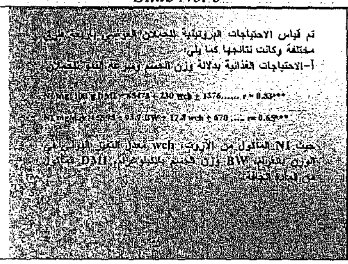

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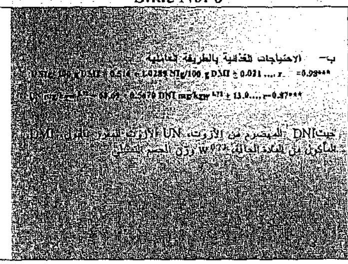

M. Dawa, Animal Nutrition Specialist /ACSAD, Damascus, Syria

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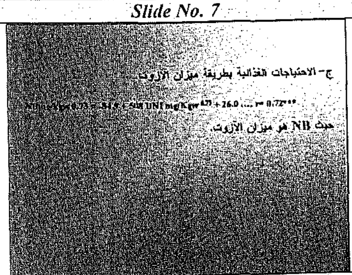

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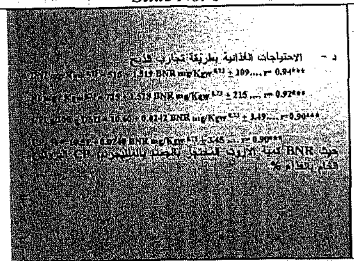

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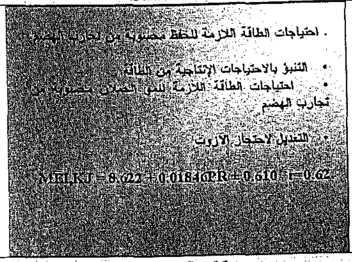

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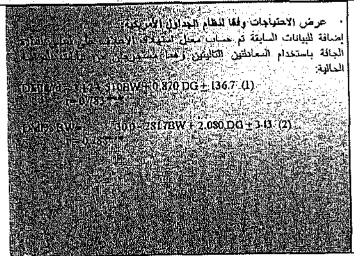

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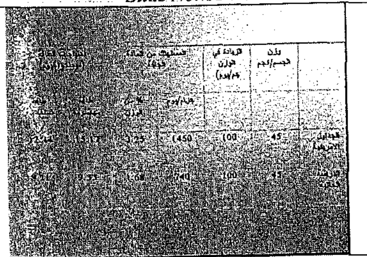

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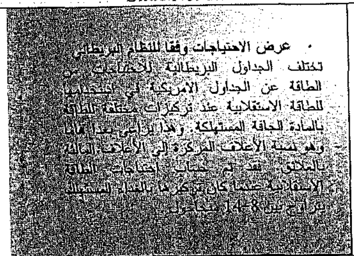

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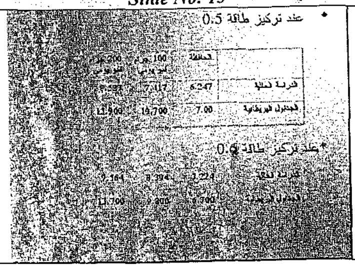

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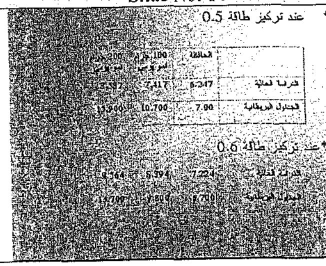

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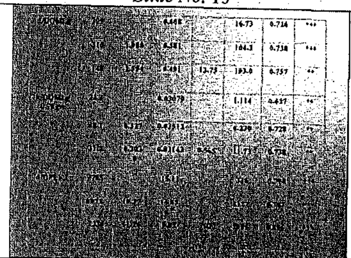

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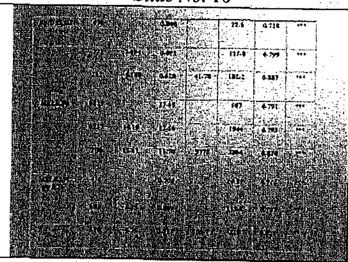

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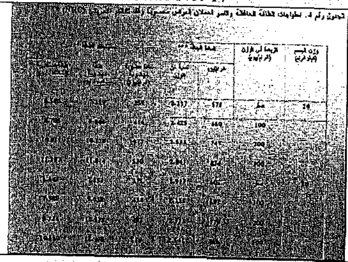

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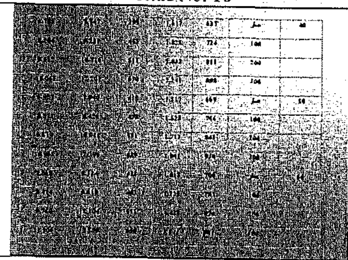

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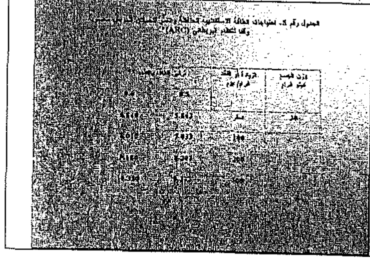

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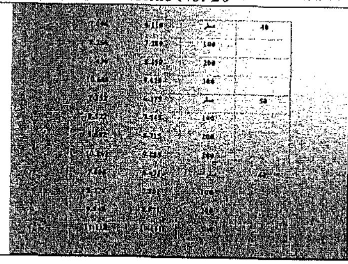
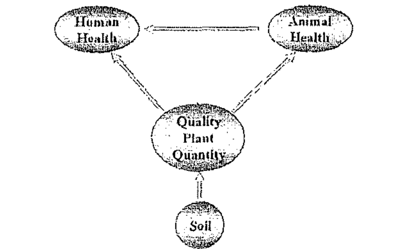


Role of Balanced Fertilization for Plants, Particularly Micronutrients, on the Quality and Nutritive Value of Crops

Slide No. 1

- Introduction
- Fertilization regimes in Near East Countries
- Micronutrient Problems in the Region
- Nutrient Management for Balanced Fertilization
- Effect of Nutrients on Quality and Nutritional Value
- Conclusion
- Recommendations

Slide No. 2



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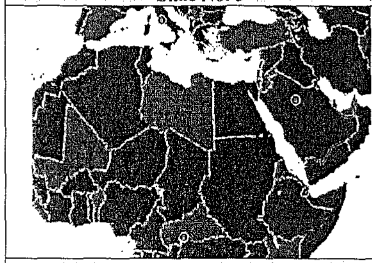
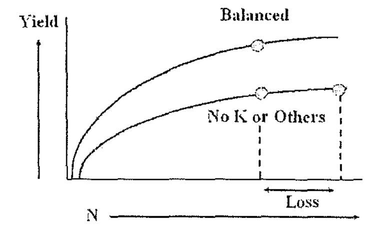


Slide No. 4

N P K ratios applied in different countries in the region

Year	N	P_2O_5	K_2O
Afghanistan	1	0.13	0.05
Algeria	1	0.47	0.1
Egypt	1	0.21	0.04
Iran	1	0.69	0.002
Iraq	1	0.09	0.03
Jordan	1	1.33	0.37
Lebanon	1	0.78	0.21
Libya	1	2.03	.14
Morocco	1	0.6	0.11
Pakistan	1	0.27	0.05
Saudi Arabia	1	0.76	0.06
Sudan	1	0.18	0
Syria	1	0.72	0.03
Tunisia	1	0.36	0.06
Turkey	1	0.74	0.01
Appropriate	1	0.4	1

Slide No. 5



Slide No. 6

Amounts of nutrients applied to produce one ton oranges and average yield in different countries

Year	N	P_2O_5	K_2O	Fruit yield (t/ha)
USA	2.3	1.5	2.5	> 48
Morocco	4.6	3.0	4.5	36-48
Egypt	19.5	4.0	0.5	14-20

M. El-Fouly: Professor of Plant Nutrition, National Research Center, Cairo, Egypt

Slide No. 7

Fertilization Regimes in the Near East Countries

Rain fed	Minimum use of fertilizer N-possibly P – No K – No micronutrient
Irrigated open System	High N – Moderate to high P – Very low K-No or moderate micronutrients
Irrigated protected agriculture (vegetables)	Very high N and P high K Micronutrients different Can be very high

Slide No. 8

Micronutrient Problems in the region

Zn	Cereals - Rice - Fruit trees
Fe	High $CaCo_3$ content
Mn	Specific crops Citrus – Potatoes – Beans - Wheat
Cu	Wheat – Forage Crops
Mo	Leguminous Crops
B	Sugar beet – Grapes - Apples

Slide No. 9

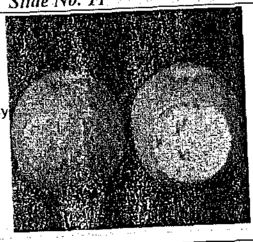
Calcium deficiency on Cucumber

Slide No. 10

Calcium deficiency on Pepper

Slide No. 11

Calcium deficiency on Apple

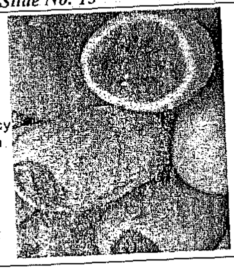


Slide No. 12

Calcium deficiency on Tomato

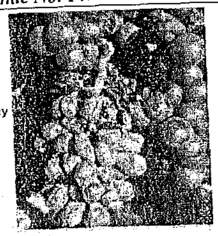
Slide No. 13

Calcium deficiency on Water Melon



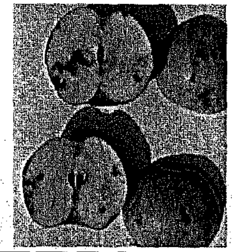
Slide No. 14

Magnesium deficiency on Grape



Slide No. 15

Boron deficiency on Apple



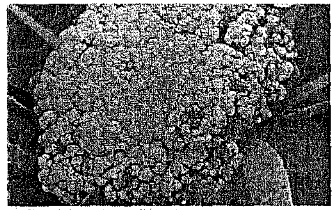
Slide No. 16

Boron deficiency on Grape

Slide No. 17

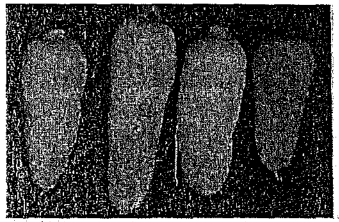
Boron deficiency on sugar beet

Slide No. 18



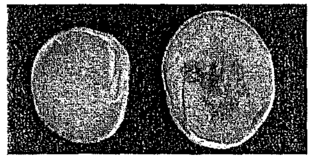
Boron deficiency on cauliflower

Slide No. 19



Boron deficiency on carrots

Slide No. 20



Manganese deficiency on bean seeds

Slide No. 21

Manganese deficiency on lettuce

Slide No. 22

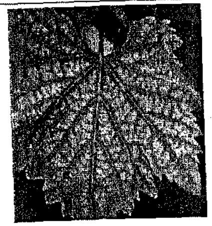
Zinc deficiency on Citrus

Slide No. 23

Zinc deficiency on Cotton

Slide No. 24

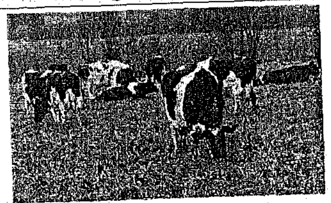
Zinc deficiency on Grape



Slide No. 25

Zinc deficiency on Maize

Slide No. 26



Copper deficiency in forage

Slide No. 27

Summary effects of individual nutrients on quality (number of citations)

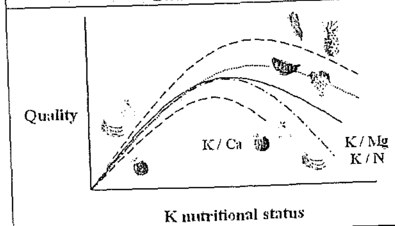
	-	(-)	=	(+)	+	?	Total
N	23	11	24	17	37	33	145
P		1	8	5	24	9	47
K	4	2	9	5	18	6	44
Mg	1		2		6	1	10
Ca			1	1	11		13
S				2	12	1	15

Slide No. 28

Summary effects of individual nutrients on quality (number of citations)

	-	(-)	=	(+)	+	?	Total
Zn	1		1	1	13	1	17
B	2		2	1	6		11
Fe			2	1	5	1	9
Mn			1		3		4
Cu	1		1		2		4
Mo			1		2		3

Slide No. 29



Slide No. 30

The effects of several potassic fertilizers on tomato quality components)

K treatment	Mean berry weight (g)	Waste (% of total yield)	Dry matter yield (Ton/ha)
Control : 0 K	124 2	15.3	2.3
KCl: 92 kg/ha K_2O	124.4	12.5	2.6
K2SO4: 92 kg/ha K_2O	126.8	9.6	2.7
Multi-K:92 kg/ha K_2O	129 0	12.0	2.9
Multi-K:138 kg/ha K_2O	120.0	10 1	4.5

Slide No. 31

Effect of Multi-K on citrus fruit rind disorders

Treatment	Nova tangerine Fruit splitting (%)	Valencia orange Fruit creasing (%)
Control	62.2 a	42.6 a
2 x foliar sprays Multi-K 5%*	19.6 b	27.6 b

* Multi-K was applied in June and on first half of August (the latter with 20ppm 2.4 D)

Slide No. 32

Effect of Fe sources on grain yield of wheat

	Rate kg / acre	Grain yield (ton / acre)
Control	0	1.7
Fe Sulphate	10	1.86
	20	1.92
Fe EDDHA	10	2.01
	20	2.19

Slide No. 33

Effect of KNO_3 and $Ca(NO_3)_2$ applications on fresh fruit quality parameters

	Width (W) (mm)	Length (L) (mm)	Fresh Fruit characteristics: Weight (g)	Fresh Fruit characteristics: Shape index (W/L)	Neck length (mm)
Control	47.8 b	37.7 ab	92.1	1.26 c	7.91
2 % KNO_3 + 2% $Ca(NO_3)_2$	53.9 a	38.3 a	97.5	1.32 abc	10.45

Slide No. 34

Mean yield per tree per different quality classes, percentage of 1st quality fruits and yield per hectar of various apple cultivars in different treatments

Varity/ Treatments	Yield per Tree kg 1st class	Yield per Tree kg 2nd class	% of 1st quality	Yield t/ha
Elaster (C)	17.1	2.0	89.5	26.7
Elaster (Zn)	21.6	5.8	78.9	38.4
Jonathan (C)	15.3	0.3	98.1	21.8
Jonathan (Zn)	23.4	0.5	97.0	13.5
G.Delicious (C)	20.7	1.8	92.0	58.5
G. Delicious (Zn)	23.6	2.0	92.2	66.6

Source : Stamper et al

Slide No. 35

Sucrose, Glucose, Fructose and Sorbitol of fresh fruit ($g\ kg^{-1}$) of various apple cultivars in different treatments

Varity/ Treatments	Sucrose	Glucose	Fructose	Sorbitol
Elaster (C)	33.93	15.35	47.02	2.67
Elaster (Zn)	38.71	15.42	51.14	3.49
Jonathan (C)	38.88	21.62	63.45	5.06
Jonathan (Zn)	41.04	22.28	63.31	6.38
G.Delicious (C)	34.54	22.80	65.94	3.44
G. Delicious (Zn)	39.37	23.53	66.24	4.59

Source : Stamper et al

Slide No. 36

Effect of treatments on fresh weight (FW), diameter (D), juice content (JC), total sugar content (TSC) and citric acid concentration (CAC) of citrus (Encore) (C. reticulata)

Treatment	FW (g)	D (mm)	JC (ml)	JC (%FW)	TSC (brix)	CAC (%)
Control	66 c	55 c	32.5 c	46.8 a	8.45 b	2.0 a
Iron sulphate	87 b	60 b	39.2 bc	48.2 a	9.02 a	1.7 b
Iron chelate	107 a	65 a	50.7 a	47.2 a	9.22 a	1.5 b
Sulphuric acid	89 b	60 b	46.2 ba	47.6 a	9.16 a	1.4 b

Slide No. 37

Dry-matter content of spinach ($g\ pot^{-1}$) parameters

Application Methods	Rates kg ha^{-1}	Soils Increasing $CaCO_3$ content 1	2	3	4	5	6
(nutrient mixture) Soil	0	2.83	2.58	2.49	2.81	2.32	2.55
	2.0	3.53	3.43	3.08	3.21	3.14	3.11
Foliage	0	2.82	2.52	2.50	2.77	2.38	2.58
	2.0	3.17	2.85	3.07	3.17	3.14	3.27

Slide No. 38

Influence of the nitrogen fertilization on yield and quality of lettuce

Nitrogen fertilization	Fresh weight g/ plant	Dry weight g/ plant	Tipburn % of plant	Nitrate content ppm
Calcium nitrate, split applications	240	14.9	31	2680
Ammonium sulphate, split applications	256	15.7	0	2350
Ammonium sulphate plus DIDIN, split applications	256	16.1	13	1629
Calcium Cyanamide, 10 days preplanting	243	15.5	6	1670
LSD 0.95	15	1.0	16	710

Source : Willumsen , 1997

Slide No. 39

Effect of Co fertilization on number of nodules N content and pod yield of peanut

Treatment	Number of nodules	Total N content in plants (% dry wt)	Pod yield (t ha^{-1})
Control	91	2.4	1.23
Seed treatment	150	2.6	1.69
Foliar spray	123	3.1	1.75
Seed treatment + Foliar spray	166	3.4	1.84

Slide No. 40

Effect of micronutrients on quality measures

(1) Fruit trees

Pears	Fe – Zn - Mn	Size fruit set / drop
Mango	Zn- Cu- B Zn B + Urea	Stem and cavity overall quality, growth TSS
Guava	Zn + B	Spoilage during room storage
Date	B	TSS, Sugars, Size Acidity (-)
Grape	Fe – Mn - Zn	Size – TSS Acidity
Strawberry	Zn - Fe	Size TSS Acid (-)
Orange	Zn	Juice TSS Vit. C

Slide No. 41

(2) Vegetable crops /forages

Onion	B	Weight loss during – Decay DM
Tomato	Zn , Fe	Marketable quantity%
Chick pea	Zn	Protein - AA
Forage	Zn	Protein

Slide No. 42

(3) Vegetable crops /forages

Cotton	Zn	Lint index
Sunflower	B	Oil / Protein (-)
Sugar cane	Zn	Sucrose

Slide No. 43

(4) Ornamentals

Chrysanthemum	Zn Fe	Size Size - duration
Rose	Fe Zn Cu	Size , Vase life Size , Vase life Size , Vase life

Slide No. 44

Conclusions

- Micronutrient effects are crucial. Most of them are influencing internal quality measures of the food
- Plant contents of micronutrients are influencing animal and human health
- Micronutrient deficiencies are wide spread in the region
- Very little information is available from the region on the effect of micronutrients on food and feed quality

Slide No. 45

Recommendations

- Work on the effect of micronutrients on food and feed quality in the region should be intensified and supported
- Balanced nutrient management systems including micronutrients should be worked out, recommended, and extended to the farmers
- Cooperation between the countries in the region should be supported
- Possibly FAO and other organizations prepare a joint project for the region

EXPERT CONSULTATION ON LAND DEGRADATION, PLANT, ANIMAL AND HUMAN NUTRITION: INTER-RELATIONSHIP AND IMPACT

COUNTRY REPORT: EGYPT

1. INTRODUCTION

Egypt climate is arid and semi-arid climate. The soils of Egypt are two main categories. The old alluvial soils which is clay in texture, low water permeability and alkaline in reaction or newly reclaimed land which either sandy (high water permeability, use of fertigation and nutrients almost nil) or calcareous (alkaline in reaction and high content of calcium carbonate). At the same time, consideration must be given to the introduction of the high yielding varieties of crops as well as those salt and drought tolerant ones. All these previous conditions show that the issue of crop fertilization is considered as a critical one.

The latest statistics (2001/2002) showed that **Egypt used the following amounts of fertilizers:**
Around 7 million tons of nitrogenous fertilizers (15.5% N)
Around 900,000 tons of phosphate fertilizers (15% P_2O_5)
Around 55,000 tons of potassium fertilizers (48% K_2O)
Around 1500 tons of zinc sulfate for rice fertilization
Around 19,000 tons of mixed and compound fertilizers

2. TYPES OF FERTILIZERS

The main types of fertilizers used are:
Nitrogenous fertilizers: Urea (46.5% N), Ammonium Nitrate (33.5% N), Ammonium Sulfate (20.6% N), and Calcium Nitrate (15.5% N).
Phosphate fertilizers: Mono super phosphate (15% P_2O_5) and Concentrated super phosphate (37% P_2O_5).
Potassium fertilizers: Potassium Sulfate (48-50% K_2O) and Potassium chloride (50-60% K_2O).
Mixed and compound fertilizers: containing N, P, K, Fe, Mn, Zn and/or Cu with different formulation either to be added to the soil or sprayed on the plants' foliage. The micro-nutrient could be either in mineral forms or chelate ones.

- **The rates of fertilizers added to the crops** differ according to the species and varieties as well as the soil type. The following table shows the rates of fertilizers added to some main crops grown in Egypt

Crop	Old Land (Alluvial Soils)		Newly Reclaimed Land (Sandy and Calcareous soils)	
	Kg N/Fed*	Kg P_2O_5/fed	Kg N/Fed*	Kg P_2O_5/fed
Wheat	75	15	110	30
Barely	45	15	70	30
Faba bean	15	30	22.5	45
Maize (Corn)	90	15	100	30
Cotton	60	22.5	75	30

S. N. Sh'aalan: Director, Soils, Water and Environment Research Institute, Agricultural Research Center, Ministry of Agriculture and Land Reclamation

Rice	50	15	--	--
Sugar beat	60	15	90	30

* Fed. = feddan (4200 m^2)

3. NATIONAL INSTITUTIONS AND PLANNING AGENCIES IN CHARGE OF SETTING FERTILIZER POLICIES AND PLANNING, ANIMAL FEED STANDARDS AND RELATED FIELDS IN EGYPT

- Soils, Water and Environment Research Institute (SWERI), Agricultural Research Center (ARC), Ministry of Agriculture and Land Reclamation (MALR)
- Animal Production Research Institute (APRI), Agricultural Research Center (ARC), Ministry of Agriculture and Land Reclamation (MALR)
- Central Laboratory for Food and Feed (CLFF), Agricultural Research Center (ARC), Ministry of Agriculture and Land Reclamation (MALR)
- Sector of Animal Production
- Sector of Economy
- Union of Producers and Exporters of Horticultural Crops Ministry of Agriculture and Land Reclamation (MALR)
- Principal Bank for Development and Agricultural Credit (PBDAC), Ministry of Agriculture and Land Reclamation (MALR)
- Companies Producing Fertilizers
- Higher Council of Fertilizers Ministry of Public Business Sector

Those are the main players in the areas of fertilizers and animal feed. On the other hand there are many other players are contributing such as Field Crop Research Institute, Sugar Crops Research Institute, Cotton Research Institute, Animal Health Research Institute, Organization of the Public and Private Sectors...

4. COUNTRY EXPERIENCES IN FERTILIZERS USE, PARTICULARLY RELATED TO MICRO-NUTRIENTS AND THEIR IMPACTS ON CROP PRODUCTION AND FORAGE QUALITY

Fertilization of crops (amount, type, timing and method of application) received high attention in the ministry of agriculture. The country achieved excellent results regarding the quantity and quality of crop production on the national scale as a result of following the fertilizer recommendations among other agronomic practices.

One of the very pronounced examples in the area of the use of micro-nutrients is the Break through that Egypt in the Rice production, which is about 9.5 tons/ha as a national average (almost double the international average). Based on the research carried out in the Soils, Water and Environment Research Institute (SWERI), since thirty years ago, it was found that Zinc is a critical element in Rice production. The government adopts this recommendation and subsidized the prices of the Zinc Sulfate to be used as a fertilizer in the rice farmers' fields.

Another example is that a research program on fodder crops reach to the conclusion that the studied fodder crops (Egyptian clover, Cow pea, Alfalfa and Sorghum) increased by 30-60% when applying micro-nutrients (Zinc, Manganese and/or Iron) in sandy soils even that the available amounts of these elements are considered adequate.

On the other hand there are different surveys and studies carried out by the Soils, Water and Environment Research Institute (SWERI) on the status of micro-nutrients in the soils of Egypt as well under certain crops (sugarcane). Also there are many research programs are currently carried out in this area.

In general, and as a research policy, fertilization and especially with micro-nutrients is considered as a critical issue in Egypt. The Soils, Water and Environment Research institute (SWERI) has a Research Unit in the Soil Fertility and Plant Nutrition Research Department dealing with this issue. There are many other research activities related to the same issue in the other research departments of the institute (SWERI).

It is worthy to mention that there are many other institution work in the area of micro-nutrient research and especially for horticulture crops (National Research Center). Many research activities are also carried out by the Universities and other research institutions in the area of micro-nutrients (chemistry in the soil, food quality, role in plant metabolism, role in health...)

5. SOME OF THE IDEAS WHICH THE COUNTRY CONSIDER AS BADLY NEEDED TO BE STUDIED

- The critical levels of the availability of the micro-nutrients in the soil In relation to crop production as we consider that the scales and figures used are almost obsolete.
- Studying the relation between the fertilization with micro-nutrients (elements, types and rates) on the quality of the crops and especially Fodder crops in satisfying animal needs of such micro-nutrients.
- The balances needed in the fertilization recommendations for the different crops to control and/or maintain their qualities either as food or feed especially the high yielding varieties, which need higher rates of the macro-nutrients (Nitrogen, Phosphorus and Potassium).

Egypt is ready to contribute and collaborate in any regional endeavors either as bilateral or group or regional projects, which may emerge from the meeting discussions.

EXPERT CONSULTATION ON LAND DEGRADATION, PLANT, ANIMAL AND HUMAN NUTRITION: INTER-RELATIONSHIP AND IMPACT

COUNTRY REPORT: JORDAN

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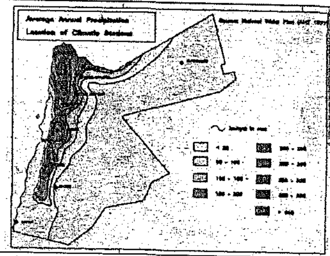

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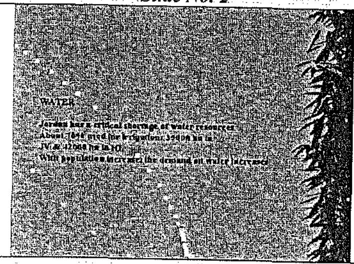

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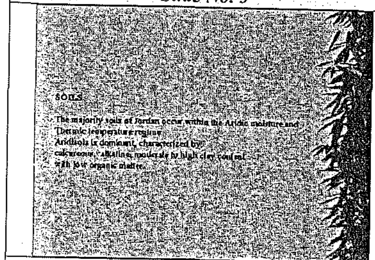

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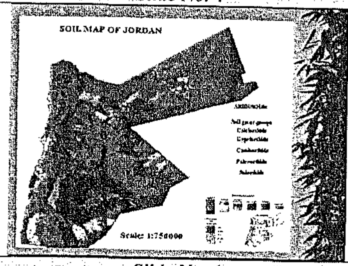

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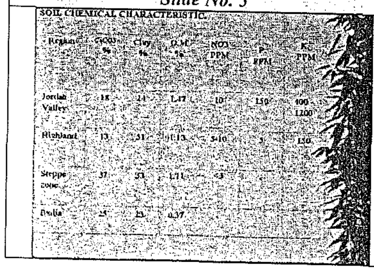

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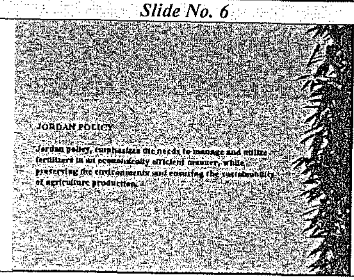

W. A. Mohamed: Head, Management of Saline and Treated Wastewater Division, Land and Irrigation Department, Ministry of Agriculture, Amman

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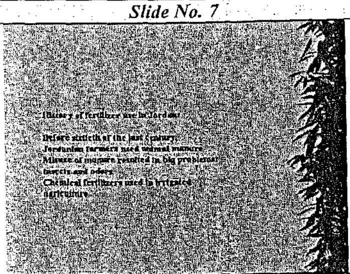

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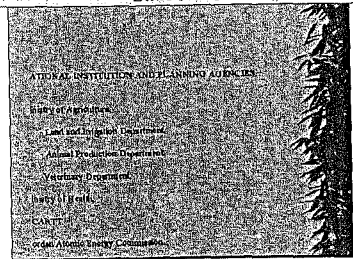

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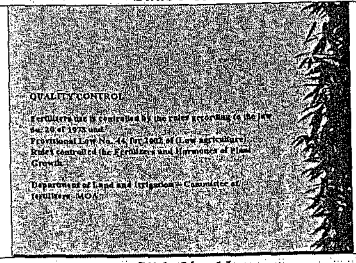

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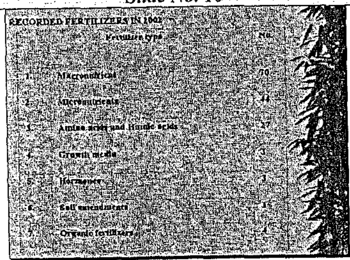

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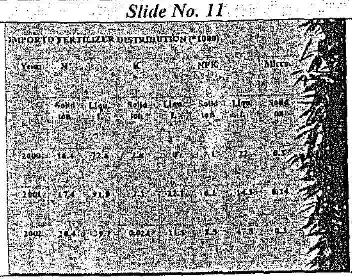

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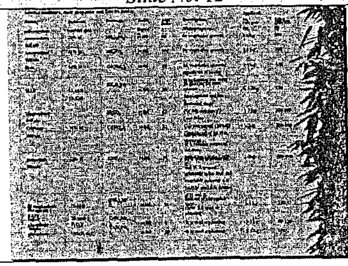
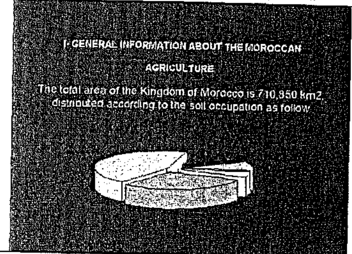


Expert Consultation on Land Degradation, Plant, Animal and Human Nutrition: Inter-Relationship and Impact

Country Report: Morocco

Slide No. 1



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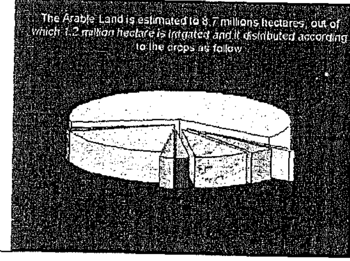

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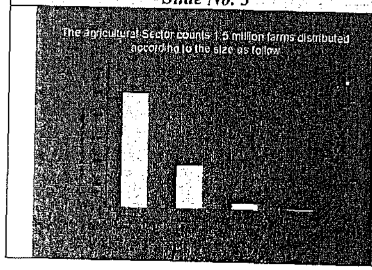


M. Hammoutou: Chief, Production Factors Supply Services, Directorate of Agricultural Production, Ministry of Agriculture and Rural Development

EXPERT CONSULTATION ON LAND DEGRADATION, PLANT, ANIMAL AND HUMAN NUTRITION: INTER-RELATIONSHIP AND IMPACT

COUNTRY REPORT: SULTANATE OF OMAN

1. INTRODUCTION

Sultanate of Oman is located in south eastern part of the Arabian Peninsula, the total area of the Sultanate is 309500 squared kilometers, and its main geographical regions are the desert area, consisting of gravel plains and sand seas.

The climate, which essentially consists of warm sunny winters and very hot dry summers, varies somewhat from region to region, with coastal areas more humid than the interior and the higher altitudes and the southern region in general more temperate year round with the exception of Dhofar governate in the south, where monsoon rains occur between June and September, rainfall throughout most of the country is low and water supply is limited

2. OMAN'S STATISTICAL DATA ON FERTILIZERS USED

It is well known that plants are the basis of food for human being & animals. Having this in mind it can be said that the role of fertilizer & water usage at the procedure of plant synthesis & growth is of great importance.

In Oman there is no fertilizer industry with an exception of Urea producing plant which is a joint venture between Oman and India governments and it is under construction in the sultanate at the time being.

The fertilizer factory will be set up to produce 1.4 million tons of urea and 330,000 tons of ammonia per year. The joint Project Company will have Oman Oil Company taking a 50% share and two state-owned Indian companies, Rastriya chemicals and fertilizer (RCF) and Kribhco evenly dividing the rest of the company's $277 million equity.

Most all fertilizers are imported from outside the country from different parts of the world.

In the Sultanate the following fertilizers are used Urea, Ammonium sulfate, ammonium nitrate, potassium sulfate, and triple super phosphate.

Commonly available compound fertilizers are in the following combination

20- 10- 10
15 –15-15
20 –20-20

Complete formulations of micronutrients (e.g. fertillion combi) and mono- formulations mainly of Iron and zinc as most citrus trees suffer of these two elements

M. M. Al-Hashmi: Plant Production Development Specialist, Ministry of Agriculture and Fisheries, Sultanate of Oman

Fertilizer consumption 2001 in Oman

NO	Fertilizer	Quantity (Mt)
1	Nitrogenous	4270
2	Phosphate	1000
3	Potash	721
Total		5991

3. FERTILIZER POLICY AND PLANNING

The government policy concerning the subject fertilizer use is targeting **the highest possible effective & efficient utilization** at the farmer level.
With **efficient fertilizer** use the policy is to have maximum use of the applied fertilizer and with effective fertilizer use the policy is to obtain optimum yield per unit of fertilizer applied.
The overall strategy is to maximize positive effects of fertilizer use and minimize environmental hazards.
Between agricultural production & environment there is an interaction which should not be competitive but complementary for balanced development.
As mentioned above Oman is not a fertilizer producing country and fertilizers are imported from different countries.
Each fertilizer imported to the country must posses importation permission from the ministry of agriculture and fisheries which is the government body in charge of setting fertilizer policies and planning.
For this each importer must supply the ministry with the necessary documents which explain in detail chemical analysis of the product, the country of origin, the year of production, the weight and other specifications which may be required.
The directorate general of specifications and measurements affiliated to the ministry of commerce and industry is in the charge of setting standards for fertilizers and animal feed in collaboration with ministry of agriculture and fisheries.

4. COUNTRY EXPERIENCES IN FERTILIZER USE

In early seventies, till end of eighties of the last century the ministry of agriculture and fisheries used to distribute fertilizers for free to farmers who participate in agricultural extension programs, after that fertilizers were subsidized in a range of (25%-50%) of its market price but that subsidy doesn't exist nowadays and fertilizers are sold within the free market mechanism.
In conditions similar to Oman where water is scarce and its cost is high, the target should be the highest income per unit volume of available water.
The efficient & effective way water and fertilizer used is obtained by proper irrigation management, changing the cropping pattern to less water demanding crops- the ministry subsidizes the implementation of modern irrigation systems all over the country by 100% of the cost of equipment, tools and materials for farms less than 10 feddans where as the farmer pays for soil digging and irrigation system installation.

Area in feddan (1 fed =4200 meters squared)

Number of farms	Total area*
2333	12050

Number of farms and total area covered with subsidized modern irrigation system in Oman

The introduction of green house techniques to the sultanate construction of green houses is subsidized by (R.O 1000) for single- span green house and (R.O 2000) for double-span green house and of course the education and training of farmers (several agricultural extension programs targeted informing farmers about characteristics, features and methods of applying fertilizers.

Number of green houses in Oman up to 2002

Total number of green houses	Subsidized	Non subsidized
914	79	835

Enhancing its fertilizers and water use policy the ministry of agriculture and fisheries conducted a soil survey and soil categorization between 1989 –1990 to pinpoint the arable land all over the country.
This project of land survey and soil categorization is considered a pre- requisite to fulfil the scientific and practical needs of modern agriculture in defining lands which are naturally highly fertile, with high productivity levels for different crops, putting other aspects of production under control and planning of projects successfully to determine best ways of land investment.
Through this vision the ministry has finalized in 1992 the land survey and soil categorization project, it spawned in the issuance of (**Soil Atlas**) which shows the geographical distribution of soil resources in the sultanate.
The study also showed important facts regarding arable lands including that there are more than two million hectares suitable for agriculture in Oman.
In line with ministry's endeavours within agricultural development and as integration for land survey and soil categorization project mentioned above the ministry in collaboration with Food and Agriculture Organization of the United Nation (FAO) conducted a comprehensive agricultural study covered (56) thousands of arable lands in the Battinah coast and all agricultural land which is (4200 ha) in Salalah plain in the south of the sultanate.
The study came out with defining the type of soil and water available, current plantations in each and every farm in the covered area in addition to determining most problems agriculture is facing, irrigation systems used, agricultural production economics, defining best suitable crop combination to meet most economical return side to side with best irrigation systems, recommendations regarding plant fertilization, plant nutritional requirements, plant protection and other cultural practices.
Latest technical methods were used in the process of statistical analysis, results extraction, and map development.
GIS (Geographical Information systems) were used quite frequently, in addition to the creation of an electronic program in the subject of soil evaluation.
This system would enable the ministry to update the study database whenever it is necessary.
The ministry is looking forward to extend the comprehensive agricultural study to other regions of the Sultanate

5. OMAN'S READINESS, IDEAS AND OR DEMANDS

From the point of view of soil in most countries in the region is a sandy, poor and deficient in organic matter with high tendency for fertilizers leaching out, mixed with high international tendency for organic farming a big deal of efforts should be exerted to make more use of organic matter – which is free of weeds, insects and diseases and concentrate research in the field.

The introduction of modern irrigation, green manure and farm residues processing piles, greenhouses, land surveys, categorization of soils, and comprehensive agricultural studies are of great importance for effective & efficient fertilizers utilization.

EXPERT CONSULTATION ON LAND DEGRADATION, PLANT, ANIMAL AND HUMAN NUTRITION: INTER-RELATIONSHIP AND IMPACT

COUNTRY REPORT: REPUBLIC OF SUDAN

SUDAN IS THE LARGEST COUNTRY IN AFRICA

Unused reserves – High potential agricultural land.
Sudan growth dominated by agriculture
Sudan economic growth dominated by agriculture accounts for 47% of GDP and 70% employment and 85% of export earning after petroleum export dropped to 19% in 2002
Population is estimated to be 32 million in 2002
Animal wealth 125 million (cattle, sheep, goats and camels)
With considerable amounts of fisheries and wildlife
Total area of the country 2.3 million km^2 of which an estimated 200 million feddans (84 million ha) of cultivable land of which 40 million feddan (17 million ha) is cultivated on average annually.

Sudan long-term agricultural strategy (2003 – 2027).
The main pillars are:

1. Land and water management
2. Transfer of technology
3. Human capacity building
4. Infrastructure
5. Rural food industry
6. International and regional trade

Strategy targeted

1. Food security
2. Increasing export earnings
3. Development of natural resources
4. Poverty alleviation
5. Front and back linkage

Policies in the Sudan

- Fertilizers application rate, time of application and the right method of application is determined by ARC.
- Fertilizers quantities each crop is determined by agric. Scheme authorities.
- Fertilizer importing is by the National Agricultural Inputs Committee.
- Sugar company ordered and import their own fertilizers by their own means.
- Private sector import less than 10% of fertilizers according to the specification of M. of Agric. & Forestry.
- Food requirement of animal nutrition is determined by the Animal Wealth Research Corporation and M. of Animal Wealth.

M. A. Salama: Deputy General Manager, Irrigation Sector, Ministry of Agriculture and Forestry, Khartoum.

Development of fertilizer use in the Sudan

1. Organic fertilizers were the first used.
2. Fertilizer research began earlier thirties in the previous century.
3. Calcareous soils of the Sudan was found to be N deficient with a reasonable P and enough K.
   - Ammonia sulphate the first inorganic fertilizer used.
   - Urea is the most used N fertilizer.
   - P deficiency in certain parts of Sudan especially for wheat and sugar cane.

Crop	Nitrogen Urea/ha	P TSP kg/ha
Cotton	33.6	
Wheat	33.6	16.8
Sorghum	16.8	
Sugarcane	84	16.8
Sunflower	33.6	-
Onions	33.6	-
Tomatoes	33.6	-

ORGANIC FERTILIZERS

- Secondary product of crops and by products of agric. industries.
- Animal, plants and trees residue.

APPLICATION FACES PROBLEMS OF:

1. Bulk transport
2. Used domestically
3. Used and animal feed
4. Building material
5. High capital investment

ADVANTAGES OF ORGANIC FERTILIZERS

1. Saving foreign currency
2. Minimization of pollution
3. Safe products
4. Need low technology
5. Improvement of soil physical and chemical
6. Provide plant by macro-micro and trace elements.

Table 2

Fertilizer required quantities for the main crops in the irrigated sector for the last ten seasons

Crop	Cotton		Wheat			Sugarcane			Sorghum		Others		Total		
Season	A	N	A	N	P	A	N	P	A	N	A	N	A	N	P
1992/93	325	26.00	790	63.2	31.6	160	32	6.4	1115	44.6	200	8.00	2590	173.8	38
1993/94	293	25.54	905	74.4	36.20	160	32	6.4	938	37.52	200	8.00	2496	177.46	42.8
1994/95	413	33.04	766	61.28	30.64	160	32	6.4	1046	44.88	200	8.00	2586	176.12	37.04
1995/96	257	20.56	703	56.24	28.12	160	32	6.4	793	31.72	200	8.00	2113	168.53	34.52
1996/97	601	48.08	775	62.00	31.00	164	32	6.56	905	36.20	200	8.00	2645	186.08	37.56
1997/98	428	34.24	621	49.68	24.84	180	36	7.20	895	35.80	200	8.00	2324	163.72	32.04
1998/99	361	28.88	319	25.52	12.76	180	36	7.20	1014	40.56	200	8.00	2074	138.88	19.96
1999/2000	419	32.28	213	17.04	8.52	152	30	6.08	916	36.64	200	8.00	1900	123.96	14.6
2000/01	393	31.44	289	22.72	11.36	160	32	6.4	1094	43.76	200	8.00	2131	137.92	17.76
2001/02	347	27.76	290	23.20	11.60	160	32	6.4	1713	69.2	200	8.00	2728	160.16	18.00
2002/03	380	30.40	308	24.64	12.32	160	32	6.4	881	35.24	200	8.00	1929	130.28	18.72

A = Area in 000 feddan

N = Nitrogen urea in 000 tons

P = Phosphate TSP in 000 tons

Others mean sunflower, maize and vegetables

Table (3)

The required demand and the imported quantities of urea and TSP for the last eleven seasons in Tons

Season	Urea			TSP		
	Required	Imported	Coverage (%)	Required	Imported	Coverage (%)
1992/93	173.8	145	83	38	60	131
1993/94	177.46	75	42	42.8	30	70
1994/95	176.12	80	45	37.04	35	93
1995/96	168.53	120	71	43.52	40	116
1996/97	186.08	120	64	37.56	30	80
1997/98	163.72	120	27	32.04	8	25
1998/99	138.88	45	83	19.98	11	55
1999/2000	123.96	115	117	14.6	32	219
2000/01	137.92	146	44	17.76	10	56
2001/02	160.16	60	78	18.00	12	67
2002/03	130.28	125	84	18.72	-	-

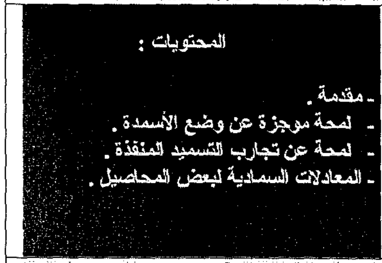
RECOMMENDATIONS

1. Imposition of laws and legislation that govern and regulate fertilizers importing, marketing, handling and safety use.
2. Completion of country detailed soil map including soil classification, soil chemical and physical properties.
3. Encouragement and support of agricultural research for determination of real demand of crops nutrients and the right type of fertilizer to be used in the different country environment.
4. Promotion of organic fertilizer usage.
5. Modernization and updating of country statistical data on crop production and fertilizer use.
6. Capacity building of personnel working in fertilizers planning and management.

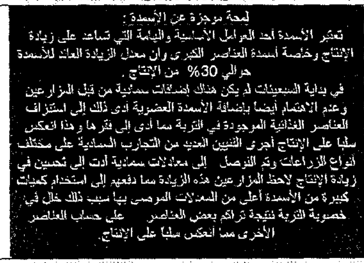
EXPERT CONSULTATION ON LAND DEGRADATION, PLANT, ANIMAL AND HUMAN NUTRITION: INTER-RELATIONSHIP AND IMPACT

COUNTRY REPORT: SYRIA

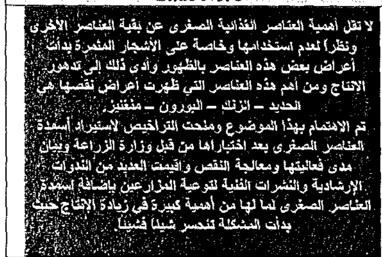
Slide No. 1



Slide No. 2



Slide No. 3



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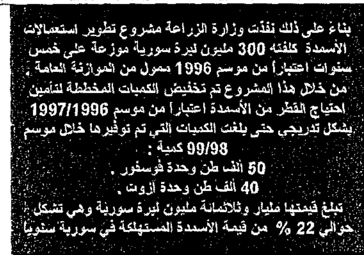

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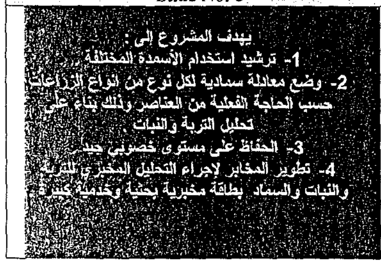
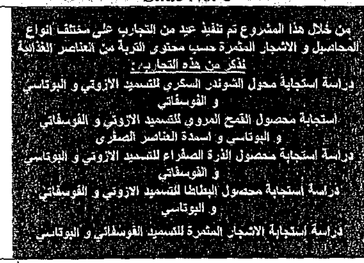


Slide No. 6



(1) Y. Al-Masri, Director of Research, Animal Wealth Directorate, Ministry of Agriculture & Agrarian Reform, Damascus. (2) F. Hamed, Head of Food Technology Department, Ministry of Agriculture & Agrarian Reform, Damascus. (3) Z. Zaher, Ministry of Agric. & Agrarian Reform, Damascus.

Slide No. 7

Slide No. 8

Slide No. 9

Slide No. 10

الاحتياج من الفوسفور على صورة كغ / p2o5/ هـ							نتائج التحاليل المخبرية
نتائج التحاليل المخبرية P p.p.m							
> 18	15.1-18	12.1-15	9.1-12	6.1-9	3.1-6	< 3	المحصول
-	30	50	75	100	120	140	حمضيات
-	30	50	75	100	120	140	زيتون - كرمة
-	30	50	75	100	120	140	لوزيات
-	40	60	90	120	135	145	تفاحيات
-	60	100	150	200	220	230	فستق حلبي
-	40	60	90	120	135	145	رمان
-	40	60	90	100	120	140	تين - كاكي

Slide No. 11

الاحتياج من الفوسفور على صورة كغ / p2o5/ هـ						نتائج التحاليل المخبرية
نتائج التحاليل المخبرية P p.p.m						
>12	9.1-12	7.1-9	5.1-7	3.1-5	< 3	المحصول
-	20	30	45	55	60	[illegible]
-	30	70	100	120	130	[illegible]
-	40	80	100	120	130	[illegible]
-	20	30	46	55	60	[illegible]
-	20	30	46	55	60	[illegible]
-	20	40	60	70	80	[illegible]
-	80	120	150	170	190	[illegible]

Slide No. 12

الاحتياج من الفوسفور على صورة كغ / p2o5/ هـ						نتائج التحاليل المخبرية
نتائج التحاليل المخبرية P p.p.m						
>12	9.1-12	7.1-9	5.1-7	3.1-5	< 3	المحصول
-	40	80	110	120	130	[illegible]
-	20	40	60	70	80	[illegible]
-	30	70	100	110	120	[illegible]
-	20	35	50	65	70	[illegible]
-	25	40	60	70	80	[illegible]
-	50	80	120	130	140	[illegible]
-	30	60	80	100	110	[illegible]

Slide No. 13

الاحتياج من الفوسفور على صورة كغ / p2o5/ هـ						نتائج التحاليل المخبرية
نتائج التحاليل المخبرية P p.p.m						
>12	9.1-12	7.1-9	5.1-7	3.1-5	< 3	المحصول
-	50	80	120	130	140	[illegible]
-	30	60	80	100	110	[illegible]
-	40	70	100	120	130	[illegible]
-	30	60	80	100	110	[illegible]
-	25	40	50	60	70	[illegible]
-	40	70	100	110	120	[illegible]
-	60	80	120	130	140	[illegible]

Slide No. 14

الاحتياج من الفوسفور على صورة كغ / p2o5/ هـ						نتائج التحاليل المخبرية
نتائج التحاليل المخبرية P p.p.m						
>12	9.1-12	7.1-9	5.1-7	3.1-5	< 3	المحصول
-	35	60	80	100	110	[illegible]
-	20	30	40	50	60	[illegible]
60	100	150	180	190	200	[illegible]
-	30	60	80	100	110	[illegible]
-	30	60	80	100	110	[illegible]
-	30	60	80	100	110	[illegible]
-	30	60	80	100	110	[illegible]

Slide No. 15

الاحتياج من الفوسفور على صورة كغ / p2o5/ هـ						نتائج التحاليل المخبرية
نتائج التحاليل المخبرية P p.p.m						
>12	9.1-12	7.1-9	5.1-7	3.1-5	< 3	المحصول
-	20	30	40	50	60	[illegible]
-	30	50	70	85	100	[illegible]
-	15	30	45	55	65	[illegible]
-	15	25	40	50	60	[illegible]
-	25	35	40	50	60	[illegible]
-	15	20	25	35	40	[illegible]
-	20	40	60	70	80	[illegible]

Slide No. 16

الاحتياج من الفوسفور على صورة كغ / p2o5/ هـ						نتائج التحاليل المخبرية
نتائج التحاليل المخبرية P p.p.m						
>12	9.1-12	7.1-9	5.1-7	3.1-5	< 3	المحصول
-	25	35	55	60	70	[illegible]
-	20	30	40	50	60	[illegible]
-	20	25	37	45	50	[illegible]

Slide No. 17

الاحتياج من الآزوت على صورة كغ / N / هـ					نتائج التحاليل المخبرية
نتائج التحاليل المخبرية N p.p.m					
> 20	15.1-19	9.1-15	5.1-9	< 5	المحصول
200	300	400	425	450	حمضيات
100	150	200	225	250	زيتون - كرمة
80	120	150	170	180	لوزيات
100	150	200	225	250	تفاحيات
100	150	200	225	250	فستق حلبي
100	150	200	225	250	رمان
80	120	150	170	180	تين - كاكي

Slide No. 18

الاحتياج من الآزوت على صورة كغ / N / هـ					نتائج التحاليل المخبرية
نتائج التحاليل المخبرية N p.p.m					
> 20	15.1-19	9.1-15	5.1-9	< 5	المحصول
-	10	20	25	30	[illegible]
100	150	200	210	220	[illegible]
50	100	175	185	195	[illegible]
-	10	20	25	30	[illegible]
-	10	20	25	30	[illegible]
-	10	20	25	30	[illegible]
-	10	20	25	30	[illegible]

Slide No. 19

الاحتياج من الآزوت على صورة كغ / N / هـ					نتائج التحاليل المخبرية
نتائج التحاليل المخبرية N p.p.m					
> 20	15.1-19	9.1-15	5.1-9	< 5	المحصول
40	80	120	130	140	[illegible]
-	40	60	70	80	[illegible]
60	80	120	130	140	[illegible]
-	30	50	60	70	[illegible]
-	40	80	90	100	[illegible]
80	120	180	190	200	[illegible]
-	40	80	90	100	[illegible]

Slide No. 20

الاحتياج من الآزوت على صورة كغ / N / هـ					نتائج التحاليل المخبرية
نتائج التحاليل المخبرية N p.p.m					
> 20	15.1-19	9.1-15	5.1-9	< 5	المحصول
40	80	120	130	140	[illegible]
20	50	80	90	100	[illegible]
50	100	150	160	170	[illegible]
40	80	120	130	140	[illegible]
-	30	50	60	70	[illegible]
90	140	190	200	210	[illegible]
80	120	156	170	180	[illegible]

Slide No. 21

الاحتياج من الآزوت على صورة كغ / N / هـ					نتائج التحاليل المخبرية
نتائج التحاليل المخبرية N p.p.m					
> 20	15.1-19	9.1-15	5.1-9	< 5	المحصول
40	90	135	150	160	[illegible]
-	30	60	70	80	[illegible]
140	180	230	240	250	[illegible]
-	20	40	50	60	[illegible]
-	20	40	50	60	[illegible]
-	15	30	40	50	[illegible]
-	20	40	50	60	[illegible]

Slide No. 22

الاحتياج من الآزوت على صورة كغ / N / هـ					نتائج التحاليل المخبرية
نتائج التحاليل المخبرية N p.p.m					
> 20	15.1-19	9.1-15	5.1-9	< 5	المحصول
-	15	30	40	50	[illegible]
80	120	138	150	160	[illegible]
40	50	92	100	110	[illegible]
-	40	69	75	80	[illegible]
-	20	41	50	55	[illegible]
-	15	25	35	40	[illegible]
-	40	80	90	100	[illegible]

Slide No. 23

نتائج التحاليل المخبرية — الاحتياج من الآزوت على صورة كغ / N / هـ — نتائج التحاليل المخبرية N p.p.m

> 20	15.1-19	9.1-15	5.1-9	< 5	المحصول
-	40	69	75	80	[illegible]
-	20	41	50	55	[illegible]
-	15	28	35	40	[illegible]

Slide No. 24

نتائج التحاليل المخبرية — الاحتياج من البوتاس على صورة كغ / K2O / هـ — نتائج التحاليل المخبرية K2O p.p.m

> 421	361-421	351-360	241-350	161-240	121-160	61-120	< 60	المحصول
-	50	100	150	200	220	240	250	حمضيات
-	40	60	80	100	120	140	160	[illegible]
-	40	60	80	100	120	140	160	[illegible]
-	40	60	80	100	120	140	160	[illegible]
-	50	100	150	200	220	240	250	فستق حلبي
-	40	60	80	100	120	140	160	رمان
-	40	60	80	100	120	140	160	[illegible]

Slide No. 25

نتائج التحاليل المخبرية — الاحتياج من البوتاس على صورة كغ / K2O / هـ — نتائج التحاليل المخبرية K2O p.p.m

> 421	361-421	351-360	241-360	161-240	121-160	61-120	< 60	المحصول
-	-	-	-	20	25	35	45	[illegible]
-	30	60	60	100	120	140	160	[illegible]
-	40	60	90	120	140	150	160	[illegible]
-	-	-	-	-	-	-	-	[illegible]
-	-	-	-	-	-	-	-	[illegible]
-	-	-	-	-	-	-	-	[illegible]
-	-	-	-	-	-	-	-	[illegible]

Slide No. 26

نتائج التحاليل المخبرية — الاحتياج من البوتاس على صورة كغ / K2O / هـ — نتائج التحاليل المخبرية K2O p.p.m

> 421	361-421	351-360	241-360	161-240	121-160	61-120	< 60	المحصول
-	40	60	90	120	140	150	160	[illegible]
-	20	30	45	60	70	75	80	[illegible]
-	-	-	20	25	30	35	45	[illegible]
-	-	-	-	-	-	-	-	[illegible]
-	-	-	-	-	-	-	-	[illegible]
-	40	60	90	120	140	150	160	[illegible]
-	20	30	45	60	70	75	80	[illegible]

Slide No. 27

نتائج التحاليل المخبرية — الاحتياج من البوتاس على صورة كغ / K2O / هـ — نتائج التحاليل المخبرية K2O p.p.m

> 421	361-421	351-360	241-352	161-240	121-160	61-120	< 60	المحصول
[illegible]	40	60	90	120	140	150	160	[illegible]
[illegible]	20	30	45	60	70	75	80	[illegible]
[illegible]	50	60	70	80	100	120	130	[illegible]
[illegible]	20	40	60	80	100	120	140	[illegible]
[illegible]	10	20	30	40	50	60	70	[illegible]
[illegible]	20	40	60	80	100	120	140	[illegible]
[illegible]	40	60	90	120	140	150	160	[illegible]

Slide No. 28

نتائج التحاليل المخبرية — الاحتياج من البوتاس على صورة كغ / K2O / هـ — نتائج التحاليل المخبرية K2O p.p.m

> 421	361-421	351-360	241-350	161-240	121-160	61-120	< 60	المحصول
[illegible]	-	20	30	50	70	80	80	[illegible]
[illegible]	-	-	15	25	35	40	45	[illegible]
[illegible]	50	90	120	150	160	170	180	[illegible]
[illegible]	10	20	30	40	50	60	70	[illegible]
-	10	20	30	40	50	60	70	[illegible]
-	5	10	15	20	25	-0	35	[illegible]
-	10	20	30	40	50	60	70	[illegible]

Slide No. 29

نتائج التحاليل المخبرية — الاحتياج من البوتاس على صورة كغ / K2O / هـ — نتائج التحاليل المخبرية K2O p.p.m

> 421	361-421	351-360	241-360	161-240	121-160	61-120	< 60	المحصول
[illegible]	5	10	15	20	25	30	35	[illegible]
[illegible]	40	60	80	100	120	140	160	[illegible]
[illegible]		20	30	40	60	80	100	[illegible]
[illegible]		20	30	40	60	80	100	[illegible]
[illegible]			-	20	35	50	60	[illegible]
[illegible]			-	20	35	50	60	[illegible]
[illegible]			-	20	35	50	60	[illegible]

Slide No. 30

نتائج التحاليل المخبرية — الاحتياج من البوتاس على صورة كغ / K2O / هـ — نتائج التحاليل المخبرية K2O p.p.m

> 421	361-421	351-360	241-350	161-240	121-160	61-120	< 60	المحصول
-	-	-	-	-	-	-	-	[illegible]
-	-	-	-	-	-	-	-	[illegible]
-	-	-	-	-	-	-	-	[illegible]

Slide No. 31

- تعتبر الهيئة العامة للبحوث العلمية الزراعية – إدارة بحوث الموارد الطبيعية هي المؤسسة المسؤولة عن الأبحاث الخاصة باستخدام الأسمدة لسنوات خلت، وإلى هذا الوقت يقتصر دورها في دراسة تأثير الأسمدة على إنتاجية المحاصيل الزراعية غذائية كانت أم علفية ولم تتطرق مراحلها البحثية لهذا المجال، هذا علماً بالإضافة إلى تحديد المستوى الأمثل من الإضافة السمادية والمعادلات السمادية لكل من المحاصيل الزراعية. أما على النطاق الإرشادي والتطبيقي والتخطيطي فتعتبر كل من مديرية السياسات الزراعية ومديرية الشؤون الزراعية هما الجهتان المعنيتان بوضع السياسات السمادية، هذا بالإضافة إلى كون المؤسسة الغذائية في وزارة الاقتصاد هي المعنية باستيراد الأسمدة وفق الخطط الموضوعة من وزارة الزراعة ويتم توزيعها عن طريق المصارف الزراعية. أما الأغذية الحيوانية وتأثيرات الأسمدة فتعتبر مديرية الصحة الحيوانية في وزارة الزراعة هي المسؤولة عن هذا الأمر.

Slide No. 32

- أما فيما يتعلق بوضع المواصفات الغذائية الحيوانية والنباتية المصدر، فتعتبر الجهة المقررة لهذه المواصفات هي هيئة المواصفات والمقاييس السورية التي تضع هذه المواصفات بعد اجتماعات عدة مع الوزارات والجهات العلمية المختلفة التي تخلص في النهاية إلى وضع المواصفة من الوجهة العلمية للموضوع، في حين أن هيئة المواصفات تصدر الصك التشريعي بذلك. ومع ذلك يلاحظ صدور بعض التشريعات من قبل وزارة الزراعة والإصلاح الزراعي.
- وتقوم حاليا إدارة البستنة بالتعاون مع قسم تكنولوجيا الأغذية في الهيئة العامة للبحوث العلمية الزراعية بإجراء الدراسات حول تركز النترات والنتريت في النباتات.

Slide No. 33

- نظراً لندرة البحوث المتكاملة عن تأثير الملوثات الكيميائية، ومن ضمنها الأسمدة، ونقص أو زيادة العناصر المعدنية الثقيلة أو النادرة على النباتات والأعلاف التي تتغذى عليها الحيوانات الزراعية، وتأثير المنتجات الغذائية الحيوانية على صحة الإنسان، فإن هناك حاجة ماسة لوضع مشاريع بحثية خاصة بكل منطقة من مناطق القطر التي تتميز بوجود مسببات تلوث عامة، لدراسة الارتباط بين أنواع وتراكيز الملوثات المختلفة في التربة أو البيئة، وفي النباتات والأغذية الحيوانية، والحالات المرضية التي يتعرض لها السكان، ليتم وضع المعايير السلامة الصحية للأغذية النباتية والحيوانية في تلك المناطق، والحلول الممكنة للمشاكل الصحية المزمنة. ومن المقترح في الخطة البحثية القادمة بحث (تأثير التسميد الآزوتي على محتوى المنتجات الغذائية والمياه الجوفية من النترات والنتريت وتأثيرها على المصنعات الغذائية) وذلك من خلال فريق بحثي من إدارة الموارد الطبيعية وقسم بحوث تكنولوجيا الأغذية.

Slide No. 34

- أما عن المشاركة في مجال المساعي القطرية مثل مشروع TCP فسيتم وبعد التسمية للخبير الاقتصادية للمشروع وبالتعاون مع منسقة المشروع إعداد ما يمكن القيام به في إطار هذا المشروع.

III
Country Reports/Presentations

Slide No. 7

Tunisia Agricultural Production

- **16 M ha**
- **9 M ha agricultural area**
  - *2.8 M ha annual crops:*
  - *2.3 M ha permanent crops*
  - *3.9 M ha permanent pastures*
- ***0.380 M ha irrigated land***
  - **30 000 ha drip irrigation**

Slide No. 8

MAIN CROPS

- **Annual crops**
- **Cereals (1.53 M ha, 75%)**
- **Fodder crops (0.22 M ha, 11%)**
- **Food legumes (0.10 M ha, 5%)**
- **Vegetable crops (0.15 M ha, 7%)**

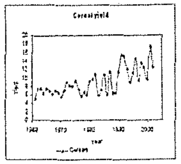
- **VEGETABLES**
  - **Tomato (27 000 ha)**
  - **Pepper (15 000 ha)**
  - **Potatoes (27 000 ha)**
  - **Melon (27 000 ha)**
  - **Others (30 000 ha)**

- ORCHARDS
  - **Olives (1 500 000 ha)**
  - **Almond (170 000 ha)**
  - Grapes (27 000 ha)
  - Pistachio (22 000 ha)
  - Peaches (20 000 ha)
  - Apricot (12 000 ha)
  - Apples (26 000 ha)
  - Pears (12 500 ha)
  - **Citrus (18 000 ha)**
  - **Date palms (30 000 ha)**

Slide No. 9

Crop yield variations

- Yield related to area harvested
- Variation in cereal yield
- When water is not limiting :Increase in yield
- However, yield is low even when water is not limiting



Slide No. 10

Water use efficiency

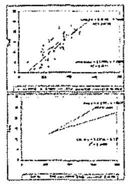
- Decreases with rainfall

Although average yields are still low

Other limiting factors:

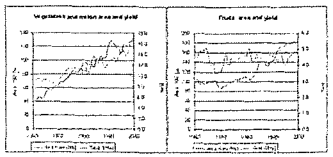
Nutrient application

Weed control



Slide No. 11

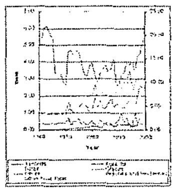
Vegetables and Fruits : Area and Yield



Slide No. 12

Fruit production and Yield

- For some species: Yield increased with the use of irrigation and change in techniques (Grapes, Apricot, peaches...)
- New varieties, fertilisation, fertigation
- Differences in yield between farmers
- (Peaches : From 4 to 40 t/ha for a late cultivar)



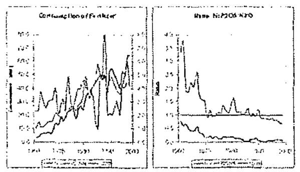
Slide No. 13

Vegetables

- Increase in Yield, in area and in production
- Use of irrigation for the main vegetables

Slide No. 14

Use of Fertiliser in Tunisia



Slide No. 15

Use of Fertiliser

Unbalanced

Between elements,

Between crops,

Between farms

N, P2O5, K2O (kg/ha)

- Cereals 22, 18
- Fodder crops 19, 17
- Fruits 24, 10
- Vegetables 51, 31

N, P2O5, K2O (1000 t, 1996)

- Cereals 33, 27
- Fodder crops 4, 4
- Fruits 4, 2
- Vegetables 6, 4

Slide No. 16

CONCLUSION

- Nutrient availability to the crop is related to several factors and nutrient application should meet the requirements of the plant
- Integrated nutrient management should take into account soil, weather and target yield for the different elements

Reason for the decrease in fertilizer usage during the last two years attributable to sharp rise in the foreign exchange rates due to recent economic cries and consequently decrease in purchasing power of farmers. As is known, state has not got any authority to interfere to fertilizer prices.
Whilst Turkish fertilizer exports reached to 379 thousand tons in 1990, this figure dropped to 119 thousand tons in 1995 and between 1995-000 remained at negligible levels of 30.000 tons. However it gained upward trend in 2001 and reached to 190 thousand tons and to 362 thousand tons at the end of year 2002.
Within the membership protocol signed with the European Community countries, under the coordination of Ministry of Agriculture and Rural Affairs, works are carried out to harmonize food, veterinary medicals, alcoholic beverage and chemical fertilizers legislations with the European Union Legislation. With this objection, Ministry of Agriculture prepared a Regulation titled "Chemical Fertilizers used in Agriculture" covering main directive no.76/116/EC (Primary fertilizers) and the second Directive amending the first one and this regulation become effective on 27th March 2002. As this regulation became effective, European Community criteria were taken into account during production and importation stages. Fertilizer bags carrying "EC Fertilizer" tags may be imported in to Turkey without analyzing at Customs gate according to free circulation of goods.
In order to protect the rights of fertilizer producers and consumers; and to control the standards of produced or imported and marketed fertilizers, market control issue have been ensured by the Chemical Fertilizer Control Regulation as promulgated on 25th April 2002
It is possible to use fertilizer according to proper technique as a result of soil and leaf analyses. In order to protect soil structure and to make it more productive, and to obtain high yield, fertilizer containing all plant nutrients needed by the soil and the plant, should be applied to the soil. If fertilizer is not used according to proper technique, after a certain saturation point exceeded, it becomes as an agent decreasing production, spoiling soil structure, deteriorating quality of drinking water, polluting under ground water as well as spoiling oxygen content of lakes and rivers and consequently causes environmental pollution. Therefore as the fertilizer supposed to be an input to increase agricultural production, it is very important to use right dosage according to crop and plant nutrition content of the soil. With this objective, fertilizer usage according to soil analyses is promoted and in order to reach to this objective, laboratories capable of carrying out soil and leaf analyses have been established.
Works to prepare regulation regarding Agricultural Sourced Nitrate Pollution presently continues, Within the European Community Harmonization legislation and under the Directive numbered 91/67/EC which restricts usage of nitrate as pollutes under ground water and spoils soil structure when excessively used.
Due to excessive fertilizer usage in all over the world, soil became deficient of organic material. Deficiency of organic material in soil, prevents plant nutrients to cling to the soil, and flow away with rain and irrigation water. Whilst we emphasize the importance of fertilizing during this meeting, I would also like to emphasize the importance of organic fertilizers and increase organic fertilizer contents with this aim, Turkey has established a commission to organize the organic fertilizer legislation, and as a result, this commission prepared the organic fertilizer legislation. Subject matter legislation have been submitted for promulgation.
In order to ensure global food security and achieve sustainable fertilizing, by taking all these factors into consideration, within a plan and program, farmers and sector should be made aware of fertilizer usage taking necessary measures to ensure protection for soil, environment and the community.

FERTILIZER PRODUCTION ACCORDING TO TYPES

TONS

Fertilizer type	1981	1990	1995	1999	2000	2001	2002	2003 June
A.Sulphate	292.596	280.662	161.404	158.600	171.980	190.671	193.649	70.576
A.Nitrate %21	49.250	0	0	0	0	0	0	0
A.Nitrate %26	902.440	1.450.419	1.226.464	1.077.666	1.070.276	866.424	960.556	517.099
A.Nitrate %33	0	0	105.795	65.514	21.958	62.281	98.356	406
Urea	456.552	563.311	566.467	150.172	105.817	116.061	448.882	207.809
Super phosphate	39.656	0	0	0	0	0	0	0
T.S.P.	661.769	224.235	53.979	87.501	66.590	44.481	60.604	42.250
DAP	311.705	355.526	204.489	236.022	138.318	87.996	163.698	99.059
Composed	615.883	0	0	0	0	0	0	0
20.20.0	0	1.009270	899.802	1.014.942	1.165.087	813607	989.963	243.157
26.13.0	0	18.492	0	930	0	0	1.300	1.500
15.15.15	0	298.822	360.269	319.186	341.357	267.814	342.931	272.932
20-10-10	0	1.663	0	0	0	0	0	2.340
12-30-12	0	0	0	97.080	16.520	77.710	114.983	87.625
10-15-25	0	0	0	0	0	0	0	11.643
25-5-0	0	42.788	6.667	0	0	0	0	0
10-25-20	0	0	0	19.153	3.543	21.485	22.000	30.112
16-20-0	0	0	0	0	0	17.858	12.335	0
8-24-8	0	55.514	164.159	0	981	0	0	0
25-5-10	0	0	21.206	75.369	60.282	61.598	19.816	28.841
15.30.15	0	0	0	0	0	0	42.743	0
Physical Total	3.329.851	4.300.702	3.770.701	3.302.135	3.162.709	2.627.986	3.471.816	1.615.349

FERTILIZER PRODUCTION ACCORDING TO KINDS

TONS

Fertilizer type	1970	1980	1990	1995	2000	2001	2002	2003 June
A.Sulphate	320.528	517.462	450.260	292.718	328.420	250.528	295.748	254.240
A.Nitrate %21	79.018	51.690	0	0	0	0	0	0
A.Nitrate %26	307.496	707.180	1.659.556	1.252.951	1.156.915	884989	957.211	861.786
A.Nitrate %33	0	0	8.722	144.559	581.114	561.246	670.027	534.380
A.Nitrate %30	27.112	369.356	627.199	580.804	842.010	718.737	718.524	521.550
Urea	0	0	0	0	118	5.986	0	0
Super Phosphate	206.864	27.075	29	0	0	0	0	0
T.S.P.	118.655	419.801	169.647	90.415	45.564	29.842	24.516	12.485
DAP	74.028	493.650	618.505	560.335	630.317	431.094	383.883	67.237
Composed	250.000	394.397	0	0	0	0	0	0
20.20.0	0	0	1.020.903	945.621	1.184.776	939.347	1.000.693	271.58
26.13.0	0	0	17.405	0	0	0	0	0
15.15.15	0	0	358.104	271.698	339.527	259.553	307.521	269.489
20-10-10	0	0	613	0	0	0	0	0
12 30-12	0	0	0	0	90.020	79.515	115.270	72.398
11-52-0	0	0	1.011	272	0	0	0	0
25-5-0	0	0	25.473	7.655	0	0	0	0
10-25-20	0	0	0	0	4.367	21.486	22.000	14.577
10-15-25	0	0	0	0	0	0	0	11.643
13-0-46	0	0	783	6.081	10.329	6.744	0	14.552
25-5-10	0	0	0	323	797	773	491	641
8-24-8	0	0	22.223	218.560	989	0	0	0
25-5-10	0	0	0	2.459	62.775	60.246	17.144	15.687
Potassium Sulphate	23.204	39.325	14.974	11.615	16.764	11.815	10.120	10.612
Physical Total	1.406.905	3.019.936	4.995.407	4.386.066	5.294.202	4.261.901	4.523.148	2.661.277

IV
Annexes

Annex 1

Expert Consultation on Land Degradation, Plant, Animal and Human Nutrition: *Inter-relation and Impact*

Damascus, Syria (20-23/9/2003)

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