

The Elimination of Iodine Deficiency Disorders (IDD) by Salt Iodisation: A Great Opportunity for the Salt Industry

Basil S. Hetzel

International Council for Control of Iodine Deficiency Disorders, Adelaide, Australia

ABSTRACT

There is now evidence that over one billion people, living where the soil has been leached of iodine in mountains and flooded valleys, are at risk of iodine deficiency disorders (IDD). Of these, 200 million have goitre (enlargement of thyroid gland) and 20 million are suffering from brain damage due to the effects of iodine deficiency in pregnancy and infancy. Iodine deficiency is the leading preventable cause of mental deficiency in the world today.

It has been shown that the effects of iodine deficiency can be totally prevented by an effective iodised salt programme in Switzerland and some other countries where formerly there was severe mental deficiency (cretinism and deaf-mutism). In other Western countries, diversification of diet has also been a factor in the correction of iodine deficiency and the elimination of IDD. In Latin America there has been considerable progress. In Asia, some progress is being made with large populations in China, India and Indonesia; and in Africa, in Algeria, Kenya and Ethiopia, but there is still a long way to go with over 30 countries affected.

There is therefore still a big gap between existing knowledge and its application for the very large populations at risk. This gap has led to the establishment in 1986 of the International Council for Control of Iodine Deficiency Disorders as a multidisciplinary global network of 300 scientists, salt technologists and public health professionals. The ICCIDD is committed to the elimination of IDD by the year 2000. It is an expert group that works closely with WHO, UNICEF and other international agencies in the promotion and development of national IDD control programmes which rely on salt iodization as the major technology for control of iodine deficiency. The supplement is usually in the form of potassium iodate providing 40-100 mg iodine per kilo depending on salt intake and conditions of delivery and storage, particularly in developing countries.

In May 1990 the World Health Assembly in Geneva accepted for the WHO the objective of elimination of IDD as a major public health problem. In September 1990 the World Summit for Children held at the United Nations, New York, was attended by 71 Heads of State and 80 other government representatives. The World Summit signed a Declaration and Plan of Action for the improved health and education of children which included the elimination of IDD by the year 2000.

Salt producers who are concerned with salt iodisation are invited to collaborate with the ICCIDD in the achievement of this great goal which would represent an even greater triumph than the eradication of smallpox because of its greater population impact.

INTRODUCTION

The elimination of iodine deficiency disorders (IDD) has been included in the Plan of Action adopted by the World Summit for Children held at the United Nations New York in September 1990. This Plan of Action was signed by 71 Heads of State and 80 nominated representatives of other governments. It represents an unprecedented commitment by governments to the future health and well being of all children in the world.

What is involved in such a commitment and how can it be achieved? First we shall need to consider the nature of iodine deficiency and its effects on human and animal populations. The all important fact is that iodine deficiency is the most common

preventable cause of mental deficiency in the world today (Hetzel, 1989). The World Health Organization has estimated that elimination of iodine deficiency would prevent the brain damage that has caused irreversible mental handicap to at least 20 million people walking around today! Then we review the remarkable success achieved by the use of iodised salt to correct this deficiency in industrialised countries since 1920.

What is the reason for drawing the attention of the salt industry to this problem? The answer is that in order to achieve the objective of elimination of IDD by the year 2000 the cooperation and support of the salt industry is vital. With such cooperation and support for the effort required we feel confident of success.

THE INTERNATIONAL COUNCIL FOR CONTROL OF IODINE DEFICIENCY DISORDERS

The ICCIDD consists of a global multidisciplinary network of 300 scientists, public health professionals, and salt technologists committed to the elimination of IDD by the year 2000. There is a Board of 32 members with a majority from developing countries (Hetzel et al., 1987; Hetzel, 1989). The major objective of the ICCIDD is to cooperate with the major international agencies, particularly WHO and UNICEF, and key bilateral aid giving agencies, in the development of national IDD control programmes in countries with significant IDD problems.

These programmes are the responsibility of national governments in developing countries yet there has been, until recently, no general awareness of the significance of IDD for national development. One major function of the ICCIDD is therefore the communication of this IDD message to decision makers or national governments, international agencies, and a wide variety of health professionals and planners and to industry. We in the ICCIDD wish to suggest that there is a great opportunity for Salt Producers to work with us towards the elimination of IDD. Let us now go on to consider the problem we have to meet.

THE ECOLOGY OF IODINE

Iodine deficiency is recognised as a global problem with an estimated population of 1 billion at risk because they live in an environment where the soil has been deprived of iodine. This arises either from the long distant past through *glaciation*, compounded by the leaching effects of snow water and heavy rainfall which removes iodine from the soil. So we find the mountainous regions of Europe, the Northern Indian Subcontinent, the extensive mountain ranges of China, the Andean region in South America and the lesser ranges of Africa are all iodine deficient. But in addition we now know that the soil of flooded river valleys is also deprived of iodine as in the Ganges Valley in India, the Irawaddy Valley in Burma, the Songkala valley in Northern China, which indicates that the problem of iodine deficiency is increasing. The deficiency in the soil leads to deficiency in all forms of plant life and cereal grown in the soil. Hence populations living in systems of subsistence agriculture are "locked into" iodine deficiency. An example is Western China (Sinjiang) where although the soil is fertile so that corn can be grown, it is severely iodine deficient with severe effects on the people, many of whom are dwarfed and mentally deficient (Fig. 1).



Fig. 1. A dwarfed cretin from Singjiang China who is also deaf mute. This condition is completely preventable. Right: the "barefoot doctor" from her village. Both women are about 35 years of age. (By courtesy of Dr. T. Ma, Tianjin, China).

THE IMPACT OF IODINE DEFICIENCY — THE IODINE DEFICIENCY DISORDERS

The continued lack of iodine in the diet leads to impaired function of the thyroid gland which enlarges to form a goitre. However in spite of this, a lowering of the level of thyroid hormone in the blood occurs with retardation of the growth and development of the individual. This effect is particularly important on the *developing brain* during periods of rapid growth, including the fetus during pregnancy, early infancy and childhood. There are also effects in the adult population, with reduced physical and mental energy due to hypothyroidism. *Iodine Deficiency is the most important preventable cause of mental defect in the world today.*

We can describe an *iceberg* of the effects of severe iodine deficiency on a population of which cretinism is the most visible manifestation (1–10%) then lesser degrees of brain damage (5–30%), with hypothyroidism causing loss of mental and physical energy much

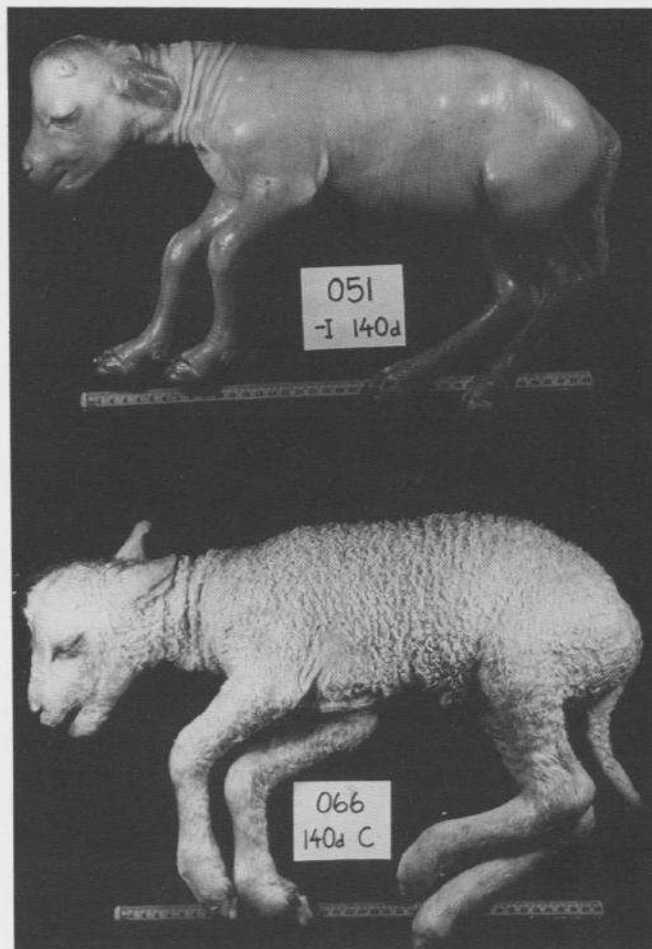


Fig. 2. Effect of severe iodine deficiency during pregnancy on lamb development. An 140-day-old lamb fetus (a) was subjected to severe iodine deficiency through feeding the mother an iodine deficient diet for 6 months prior to and during pregnancy (full term 150 days) compared to a control lamb (b) of the same age fed the same diet with the addition of an iodine supplement. The iodine deficient lamb showed absence of wool coat, dislocation of the leg joints, with a smaller brain. The figure illustrates that iodine is essential for animal development.

more common (30–50%). All these effects are included in the term iodine deficiency disorders (IDD). They can all be prevented by correction of the iodine deficiency. In the more severely iodine deficient communities there are so many affected that the quality of social life is greatly reduced with effects on school performance in children and productivity in adults. There are also significant effects on *livestock*, with impaired reproduction in poultry, sheep, goats and cattle (as also in persons) with reduced wool growth and milk production and reduced survival rates in offspring (Fig. 2).

The extent of IDD in the world has now been estimated by the World Health Organisation (1990).

In the at risk population of 1 billion, in excess of 200 million have goitre and 20 million have some degree of brain damage due to the effects of iodine deficiency in pregnancy.

We can deduce for any country with a population of 1 million exposed to severe iodine deficiency — 200,000 will have goitre and 20,000 will have some degree of brain damage. Many countries have populations up to 1–20 million at risk, with China 400 million and India 200 million at risk (Fig. 3). All these effects can be completely prevented by correction of iodine deficiency as was shown first in Switzerland. Some like hypothyroidism can be effectively reversed by iodine after they have developed, but the effects on the brain in early life are irreversible.

It is important to realise that iodine deficiency is still present over very large areas where the soil is deprived of iodine. However since 1920, the effects of this iodine deficiency have been eliminated in many industrialised countries in North America, Northern Europe, Australia and New Zealand by the addition of iodine to the diet. *The great challenge is to eliminate IDD from all countries by the year 2000 just as it has already been eliminated in most industrialised countries.*

IODISED SALT

It is most economical to correct iodine deficiency by the addition of iodine to the diet. This can be done through the addition of iodine to salt, water, various sauces or in an oily form.

Iodised salt is the major resource for the elimination of IDD by the year 2000. Iodine in the form of potassium iodate can be readily mixed with salt at concentrations of 40–100 mg iodine per kilo. The concentration used depends on the level of salt intake, the climate and the distance it has to be transported to provide the essential requirement of 150–200 micrograms (μg) of iodine per day — the equivalent of less than a teaspoonful for a whole lifetime! (Mannar, 1987).

It has been shown that the effects of iodine deficiency can be totally prevented by an effective iodised salt programme in Switzerland (Burgi et al., 1990) and some other countries where formerly there was severe mental deficiency (cretinism and deaf-mutism). In other Western countries, diversification of diet has also been a factor in the correction of iodine deficiency and the elimination of IDD. In Latin America there has been considerable progress. In Asia, some progress is being made with large populations in China, India and Indonesia; and in Africa, in Algeria, Kenya and Ethiopia, but there is still a long way to go with 39 countries affected.

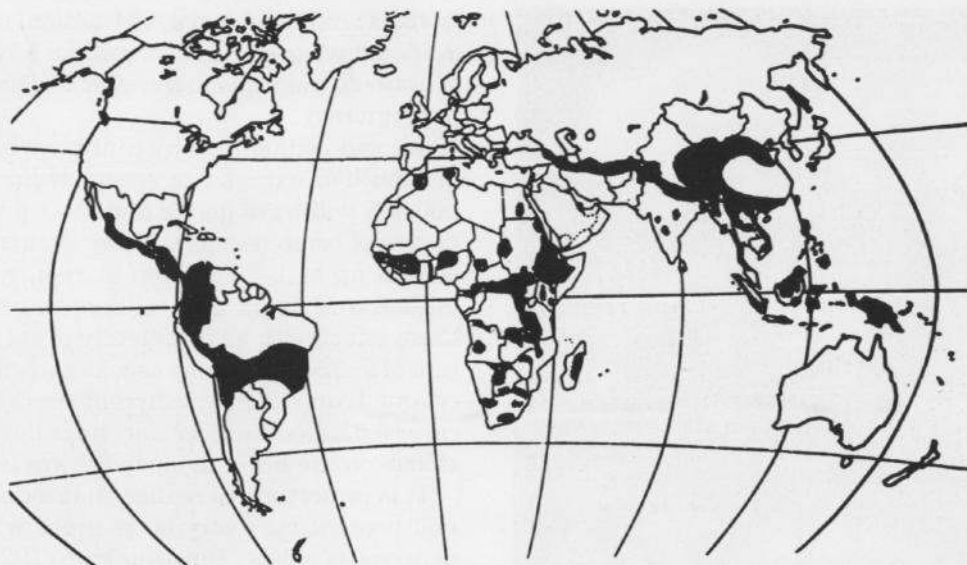


Fig. 3. The map shows the distribution of iodine deficiency disorders in developing countries. Large populations in Asia provide 2/3 of the 1 billion at risk due to iodine deficiency of the soil.

In India, the production and transport of iodised salt from the salt sources in Rajasthan, Gujarat and Tamil Nadu to the iodine deficient areas mainly in the Himalayan belt, has now reached 2.5 million tonnes per year. In the past 3 years an imaginative plan has been developed for Africa whereby iodised salt sources in Cameroon, Botswana, Tanzania and Kenya are now reaching neighboring countries (Fig. 4). The major source in Senegal will, we hope, follow shortly, with supplies to 10–15 West African countries.

An effective iodised salt programme takes time to organise — if there is severe IDD then iodine in an oily form can be given by injection or by mouth — a single dose lasting up to 5 years. This provides instant correction of iodine deficiency and total prevention of the damaging effects of iodine deficiency in pregnancy, infancy and childhood (Dunn, 1987).

NATIONAL IDD CONTROL PROGRAMMES

In the past IDD control programmes have been conspicuous for their failure, in spite of the availability of effective technology in the form of iodised salt. We now recognise that there is a social process involved which requires political will, expertise, training, as well as funding (Hetzel et al., 1987; Hetzel, 1989). Resources have now become available to meet these challenges and we now understand much better what is involved so that an increasing number of effective national programmes are being established.

We have found a model useful in the form of a "wheel" to show what is involved in such a national programme (Fig. 5). The wheel has to keep turning

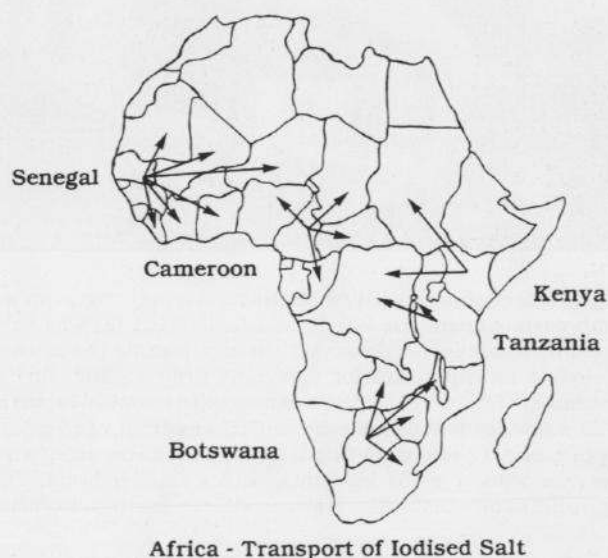


Fig. 4. Map of Africa showing the major site for production of salt-iodisation of the salt for human consumption from these various sources including also Ethiopia, is now being achieved with great benefit to the countries involved. (Courtesy Dr. K.V. Bailey).

in order to maintain a salt iodisation programme. There are six major components or steps:

1. *Assessment* of the IDD problem with estimates of the population at risk, the prevalence of goitre and cretinism, evidence of iodine deficiency from measurement of urine iodine excretion and measurements of the thyroid related hormones. These measurements require suitable laboratories. Effects on livestock can be noted. In addition the nature and

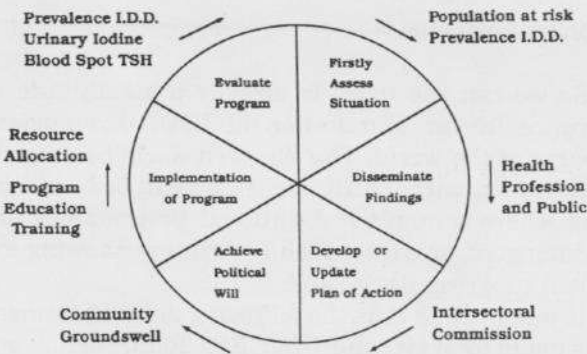


Fig. 5. Model of a National IDD Control Programme. The "Wheel" has to be kept turning for a programme to be effective. The process involves a multidisciplinary intersectoral effort under the supervision of a National IDD Commission.

operation of the salt industry must be assessed to enable planning to proceed for salt iodisation.

2. *Communication* of the problem to the public and the politician, in terms that they can understand, effects on growth and development of children, including the prevalence of handicapped (cretins), reduced school performance, and reduced productivity and quality of life in adults. The effects on livestock can also be highlighted.

3. There is the *development of a plan* including the salt industry, the education system, and the media as well as the public health professionals. Consumers should be represented. This requires an intersectoral commission with a chairman carrying sufficient political authority to implement the plan once it has been approved by the government.

4. *The political decision* which includes an allocation of the necessary funds from the government sources within the country supplemented by external funds from bilateral and/or multilateral sources. As already indicated, recent estimates indicate the cost of iodised salt is approximately 5 cents per person per year (less than the cost of a cup of tea in many countries) and for iodised oil, 20 cents per person per year. These costs are indeed modest when compared with the benefits.

5. *Implementation*, including the organisation of the supply of iodised salt, iodised oil (if necessary), appropriate training and education programmes. An emergency phase using iodised oil may be required for a region with cretinism and severe iodine deficiency for the immediate prevention of cretinism and lesser degrees of brain damage.

6. *Monitoring and evaluation* of the programme. This requires process indicators such as the delivery of iodised salt, checking its iodine content in the factory, on arrival at the destination and in the home. It includes the determination of iodine in the

population by measurement of urine iodine and the assessment of thyroid hormone output by measurement of thyroid related hormones.

Outcome measurements include evidence of reduction of goitre prevalence by palpation or using ultrasonography for more accurate assessment; and the reduction of cretinism including deafness and improved school performance. All these methods are being used to evaluate the programmes in a number of countries.

There are very significant economic benefits from iodisation programmes both for human and animal populations. These benefits include increased work output, improved learning performance of school children, improved quality of life and in animals, improved reproduction capacity, and greater meat and milk production.

REGIONAL SUPPORT

The establishment of an effective national IDD control programme requires technical help. Help with the surveys and the laboratories with the appropriate quality control that is required is available to national governments. To facilitate this, Regional IDD Working Groups have now been established in all parts of the world — Africa, south-east Asia, the Middle East, Latin America, Indonesia, and China — to assist national governments in all aspects of the establishment of national IDD control programmes. These Regional IDD Working Groups include representatives from WHO, UNICEF and the International Council for Control of Iodine Deficiency Disorders (ICCIDD), interested Bilateral agencies and representatives of National Governments.

THE TARGET OF ELIMINATION

Since the World Summit for Children, UNICEF, WHO and ICCIDD have agreed on a series of targets to be met over the next 10 years in order to achieve the objective of elimination of IDD as a public health problem by the year 2000. *The elimination of IDD by the year 2000* requires the operation of demonstrably effective national IDD control programmes using iodised salt in all countries with a significant IDD problem reducing the potential of large populations as already stated. The indication for this is a goitre prevalence of 10% or more with laboratory evidence of iodine deficiency. Higher goitre prevalence is associated with increasing mental disability with up to 10% rates of fully developed cretinism in severely iodine deficient local communities. If effective, salt iodisation is not possible, then iodised oil may still be necessary.

For 1995 realisation of the objective requires that all countries should have National Intersectoral Commissions operating national programmes with access to laboratory assessment of salt iodine content and monitoring of the extent of iodine deficiency in the population. Measurement of salt iodine requires only a simple chemical procedure which can be made readily available. Bigger countries with large iodine deficient populations will need their own specialised laboratories — expertise is already available in a number of them. For smaller countries access to regional specialised laboratories is being organised.

PROGRESS TOWARDS THE TARGET OF ELIMINATION

What then is the present state of IDD control in the world today? We can best consider this by region.

In Europe elimination has been achieved in most, but not all countries — Germany, Italy, Spain, Poland, Rumania, and the USSR, and others still have to make their control programmes fully effective for their whole iodine deficient population.

In Latin America the 1995 objective of the establishment of National IDD control commissions, with IDD control units, has been achieved in nearly all countries. Significant challenges remain in Peru, and Central America. Great progress has recently been made by Ecuador and Bolivia.

In south-east Asia the objective of 1995 has almost been achieved, with national programmes operating in most countries. India, Indonesia, Nepal, Burma, Thailand and Bangladesh have made good progress but still have some distance to go to cover their whole populations.

In Africa there is the furthest to go with significant problems in no less than 45 countries including 6 in Northern Africa.

The spectacular progress made since the establishment of the IDD Task Force for Africa encourages the hope that the 1995 objective can be achieved within the next 2–3 years. With effective regional organisation of the supply of iodised salt already initiated, control should be achieved by 2000. In China, a complete review of the National Programme is being undertaken in consultation with the International Working Group for IDD Control in China. Remarkable progress has already been made with a population of 400 million at risk. Isolated areas in Sinjiang and Tibet remain a difficult problem.

CONCLUSIONS

So we can see there is already a steady tide of advance in the elimination of IDD, this ancient scourge of the world. The Western world has nearly achieved it, with Latin America next, followed by Asia where a number of national programmes are making good progress. Finally Africa is showing excellent progress since 1987.

It was in 1978 that the following Joint Statement was made by WHO and UNICEF: "Iodine deficiency is so simple to prevent that it is a crime to let a single child be born medically handicapped for this reason". Many children are still being born with this handicap: 20 million of them are walking around today. We would value greatly the assistance of the salt industry in overcoming this ancient scourge of mankind.

ACKNOWLEDGEMENTS

Figures 1 and 2 are reproduced with permission from "The Story of Iodine Deficiency", by B.S. Hetzel, Oxford University Press, Oxford and Delhi, 1989.

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FURTHER READING

The author's book "The Story of Iodine Deficiency: an International Challenge in Nutrition", OUP, Oxford, Delhi, 1989, provides a comprehensive account of iodine deficiency, its effects, and a strategy for its control at national, regional and international levels.