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Water-efficient sugarcane farming

1. GENERAL INFORMATION

1.1 Title of practice or experience

Water-efficient sugarcane farming

1.2 Category of practice/experience and brief description

A series of extremely intelligent modifications to the conventional package of practices associated with sugarcane farming developed by Suresh Desai, a sugarcane farmer in the Belgaum district of Karnataka state, South India, has enormous implications for the raising of sugarcane on farms in tropical countries.

The modifications drastically reduce the requirement of water in irrigated sugarcane plantations by approximately 75% and are basically in the nature of good practices as they encourage the use of existing resources in more efficient ways. In fact, because of their proven efficiency, the practices actually reduce the need for scarce resources. Yet they are able to achieve this economy without compromising on yields.

Traditionally, sugarcane has always been considered a water-guzzling crop. Where there is no water, sugarcane cannot be planted. Very often, lack of reliable water supply can lead to destruction of the entire standing crop or generate heavy crop losses.

The intensive demand for water, in turn, generates pressures for expensive irrigation systems, including canals. Such demands can be troubling, particularly in areas where resources are already scarce and administrators are keen to allocate them to more critical areas.

The modified package of practices described here does not require such costly investments, in the form of either large-scale development projects or capital or equipment. It also provides a unique example of sustainable agriculture as it succeeds in maintaining overall productivity without compromis-

ing the ecological basis of agriculture. In actual fact, it enhances soil quality, in contrast to other conventional methods.

1.3 Name of person or institution responsible for the practice or experience

Suresh Desai

1.4 Name and position of key or relevant persons or officials involved

As in 1.3 above

1.5 Details of institution

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2. THE PROBLEM OR SITUATION BEING ADDRESSED BY THE PRACTICE/INNOVATIVE EXPERIENCE

Sugarcane is one of the most significant commercial/cash crops grown by farmers in countries of the South. Farmers plant sugarcane because it receives strong state support; sugarcane factories located in sugarcane-growing areas take up the sugarcane for crushing as soon as it is harvested; and development agencies allocate water resources and electricity connections on a priority basis for those areas growing the crop.

Sugarcane cropping is generally admitted to be resource-intensive. Only those farmers who have ready access to cash or credit, irrigation and water supply, fertilizers and pesticides can farm sugarcane. The sugarcane plant requires steady irrigation for its growing period of 18 months to 2 years, so

subsistence farmers are unable to farm sugarcane since sole reliance on monsoon supplies is inadequate. Payment for sugarcane also comes in lumps, but only after the harvest has been crushed at a sugarmill. Therefore, only those who can survive on such a system of deferred payments plant this crop.

The heavy requirement of water for sugarcane growing is one of the major question marks hanging over any extension of areas to sugarcane development. The allocation of such vast quantities of a precious resource to what is actually a privileged crop has had serious negative consequences for agriculture as a whole. The example of even well-endowed states like Maharashtra in western India is instructive.

Sugarcane in Maharashtra state is the major cash crop, but it is actually grown in drought-prone areas. This has meant the development of expensive artificial irrigation projects. 60% of the water from these projects is now used to irrigate 500,000 hectares of sugarcane-growing land (which amounts to 3% of the cropped area in the state). This means that other crops and non-sugarcane farmers can hope to get little or no water at all.

Traditionally, sugarcane is assumed to be a water-guzzling crop: farmers and agricultural scientists have in fact always assumed that the sugarcane crop requires a considerable amount of water to flourish. Therefore, the present or conventional package of practices recommends providing sugarcane fields 100% coverage in terms of water as essential. Farmers are advised to create extensive channels in their fields through which the water can be supplied directly to the roots of plants, flooding them in fact.

Since water of this quality and quantity is not going to be available in most places naturally, sugarcane growing requires infrastructure, particularly the erection of resource-demanding large dams, canals and lift irrigation schemes. The resource demands for such large schemes can be troubling, particularly in countries and areas where funds are already scarce and required for more critical areas.

Besides its heavy demand for irrigated water supplies, intensive sugarcane farming is ecologically destructive in several documented ways. Artificial irrigation often leads to waterlogging and salinity. The continuous, intensive growing of sugarcane in the same plot will generate symptoms associated with soil mining and soil sickness. This is because of the heavy use of synthetic fertilisers and pesticides.

The use of chemicals leads to a progressive decline in soil fertility since the soil fauna (including earthworms) and microbes are gradually eliminated. The more fertilisers are used, the more water is required.

Because of these unhealthy growing conditions, the sugarcane is prone to disease and therefore requires the use of more and more pesticides and fungicides.

Conventional practices recommended to ensure that any pathogens from the standing crop do not contaminate the following crop include completely burning the sugarcane waste in the field, which causes serious air pollution.

The practice is unsound because it leads to the unnecessary elimination and waste of significant quantities of organic materials which tropical soils are already deficient in. The other measure followed to dissuade pathogens is maintaining a regular period of fallow between crops every two years. None of these agricultural routines can be said to be a good practice.

In Suresh Desai's scheme of sugarcane planting, most of these practices have been eliminated precisely because they are ecologically harmful, unsustainable in the long term and require a lot of resources. Desai uses very little water compared to farmers elsewhere, yet he is able to maintain yields every year. In addition, he rejects the use of synthetic fertilisers and pesticides altogether.

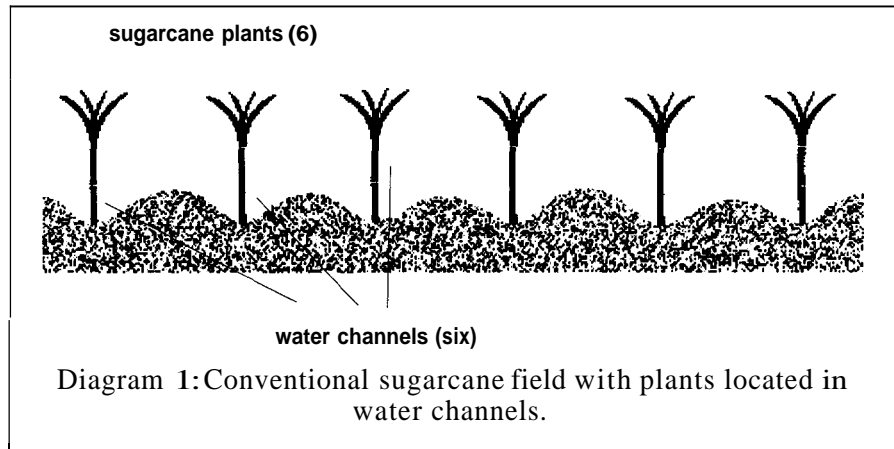
What Desai has in fact perfected is an organic method of growing sugarcane in which he uses tried and tested farming techniques to replicate a natural growing environment in which sugarcane plants thrive. His innovations will therefore be of enormous interest to farmers everywhere, and all the more so because his methods do not require hefty cash balances or the importation of expensive machinery or non-farm inputs. This good practice is invariably cost-effective and is attractive for precisely that reason.

3. DESCRIPTION OF THE PRACTICE/INNOVATIVE EXPERIENCE AND ITS MAIN FEATURES

Suresh Desai has evolved his organic farming system for growing sugarcane on a trial-and-error basis over the last six years.

As a conventional farmer, he originally relied on synthetic fertilisers for raising his crops on the six acres of irrigated land he and his brother (Ramesh) worked on. However, after several years of experience, he decided to discontinue the use of chemical fertilisers and pesticides because he was personally convinced that these damaged the environment and affected public health.

Desai is also acutely aware that water supplies are dwindling, not increasing. Therefore, out of self-interest, he decided to reduce dependence on water for his sugarcane crops. His objective was to investigate whether he could get his fields to produce a steady yield on a sustainable basis for as many years as possible. His first urgent aim, therefore, was to reduce the amount of water required by the plant. Sugarcane growing in his area was based on the practice of 100% irrigation. This means, in other words, that the entire field area in which the sugarcane is growing is irrigated. Sugarcane fields are therefore arranged in rows of water channels.

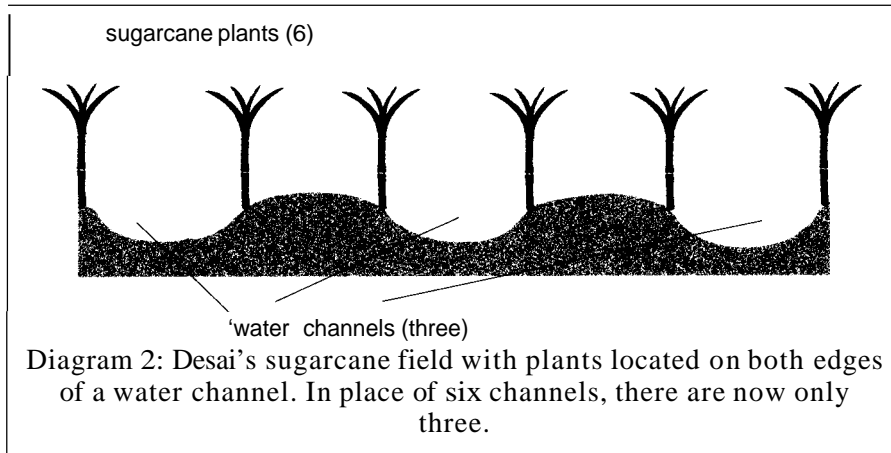


After close observation, Desai came to the conclusion that farmers and agricultural scientists were making a big mistake in flooding the soil with irrigation water when all that the plant really required was soil moisture (and not soil wetness). He decided that the conventional practice of flooding the root zones of the crop actually damaged soil aeration, reduced soil fertility, and consequently made the plants susceptible to disease. It was also entirely unnecessary. In order to eliminate the resulting diseases that were in a sense inevitable, farmers were taught to burn the crop residues after harvesting the cane.

Desai began by first putting an end to the use of synthetic fertilisers. He switched to oilcakes instead (as a transitional measure; today, he does not use any external inputs). One of the principal reasons for suspending the use of synthetic chemicals was their devastating impact on earthworm populations.

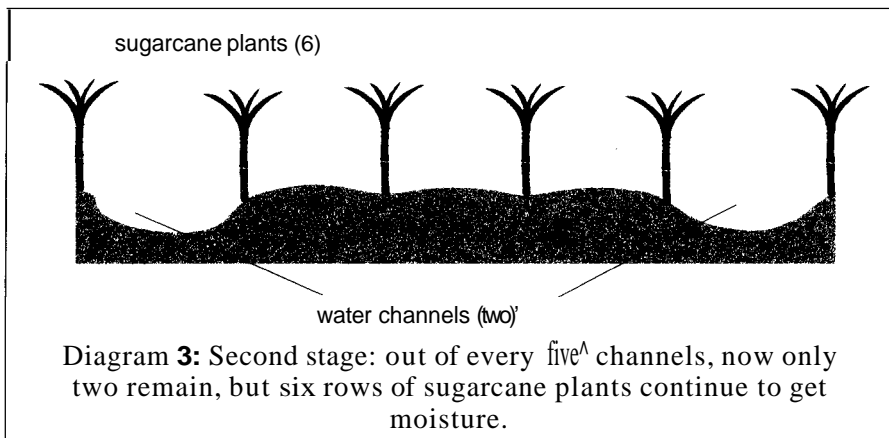
Next, he redesigned the irrigation channels in his farmlands and began by reducing their number by half. This he did by eliminating every alternate channel. Thus, for every channel that he kept, one was eliminated. The channel that was eliminated was earthed up and turned into a bed of mulch in order to facilitate the retention of moisture in the soil. As he increased the quantum of organic matter in the mulch bed, he discovered the field as a whole was now able to retain far greater moisture than before and supply the growing sugarcane with moisture as required.

As Diagram 2 shows, the topography of his sugarcane fields was altered and this reduced water supply to the field area by 50%. Desai found that by doing this, the number of irrigations required also decreased. He was then required to irrigate his sugarcane only 9 to 10 times for the entire duration of the crop. This was because the soil was by now so rich in organic matter, the top stratum had been transformed into what he calls a 'bio-film' – a rich,



loamy layer of soil that is not only densely populated by earth fauna like earthworms, but one that has also been taken over by entire colonies of beneficial fungi aiding the decomposition process by enhancing the breakdown rate of the organic matter placed in the field. Due to this composition, the soil not only retains the moisture it receives through the channels, but actually circulates it even to those areas that are not directly touched by water channels.

Three months later, Desai further modified his water-channel system to eliminate one more set of water channels. In other words, he reduced the number of water channels further by another half. He was able to do this simply because the water-retention capacity of his soils had further increased due to the measures adopted earlier. Now where other farmers maintain four water channels for four rows of sugarcane plants, he has succeeded in being able to raise four rows of plants with only one channel of water.



Desai cautions that one cannot immediately reduce water consumption by 75% but that the farmers must proceed in stages. The first step is to reduce the existing water channels by half, and this is an essential first step.

Thereafter, after three months or so, one can further reduce the channels by another half. The stages are necessary simply because the habit of water movement through the channels must first be stabilised during the first stage before the next stage is attempted. Failure to follow this principle would lead to unsatisfactory results.

Farmers realised that the new system of irrigation that Desai developed did not damage the root zone of the plants nor did it harm the structure of the soil. As the population of earthworms increased, moisture percolation and aeration improved.

Desai has also been experimenting with different substances that will support and enhance the nutrients available to the growing plants in the soil. For example, he introduces a mixture of jaggery, yeast and cowdung into the water channels to enhance microbial activity. He also grows plants which he calls 'aurogreens' that have symbiotic effects on the sugarcane, like horsegram. When the leaves of the horsegram fall into the water channels, they decompose to provide urea. Desai also grows turdhal (a lentil) partly for consumption and partly for mulching purposes. He says small additions of these kinds of plants are adequate for plant nutrition provided the soil has been strengthened by appropriate measures like the addition of organics and the creation of microclimates supportive of the growth of earthworms and beneficial fungi.

Since the plants are growing in an ideal environment and do not have to cope with the difficult problem created by too much water at their root zones (as in the other 100%-irrigated farms), Desai has found he does not have to rely on chemical pesticides for dealing with any pest or fungi attacks. Healthy plants are not susceptible to pest attacks. For this reason, he does not have to keep his fields fallow and burn the residue every three years as is customary but can maintain the growing of sugarcane continuously in his fields.

Burning of organic matter is a completely destructive practice as soils in tropical areas are generally bereft of or deficient in organic matter and burning reduces the stock of such organic matter even further. No sensible agricultural scientist would advise burning of any organic material in the fields for this reason. However, since agricultural scientists today are largely unofficial agents for the manufacturers of synthetic fertilisers and have grown used to the idea that crops can be raised solely with such fertilisers, they have maintained a rather callous attitude towards the importance of the humus content of the soil. Many of them feel there is no need whatsoever to have any humus or organic-matter content in the soil.

Desai's system has other advantages compared to conventional sugarcane farms.

Heavily-endowed sugarcane farms today produce an average of 60 tonnes per acre. However, as we have noted already, there are several problems with the system of practices that results in such yields and it is not quite clear whether the farmers profit more from an average yield of 60 tonnes using large quantities of water, chemicals and pesticides than from an average yield of 40 tonnes with a 75% water reduction and without the use of chemicals and pesticides.

Conventional practices recommends that a ratoon crop be taken after the harvesting of the first crop. Fields producing an average of 60 tonnes must have recourse to keeping the land fallow every three years, after the removal of two harvests.

In conventional sugarcane farming, a sugarcane crop takes approximately 18 months; thereafter, a ratoon crop is also taken. After the harvest of the ratoon, the entire crop residue is to be burnt on the field and the land kept fallow till the next planting, which may take anything from six months to a year. Thus, fields must be given a rest, so to speak, and during this period cannot be used for growing further crops.

Thereafter, considerable use of labour is required to plant the field afresh with fresh planting material. The cost of replanting a sugarcane field with new clips comes up to anything between Rs.4,000 - Rs.6,000.

In Desai's package of practices, the soil buildup is so dramatic, he is able to continue ratooning his crop everytime it matures without any attendant loss of output. He has already by now subjected his sugarcane fields to six ratoons and claims he will eventually reach twelve.

As Desai does not have to keep any of his fields fallow and his yield is a steady 40 tonnes per acre, he eventually harvests as much sugarcane over a three-year period as the farmer who raises 60 tonnes (also over the same three-year period).

The quality of Desai's sugarcane is also better. As it is purely organic, the sugar recovery is higher at 120kg per tonne compared to conventional farms where sugar recovery remains around 100kg per tonne.

Furthermore, in his case, as there is no fresh planting every three years, a lot can be saved on labour costs. In general, Desai has found that labour costs on his farm have been reduced by approximately 30% due to this and other factors.

In other words, seasonal sugarcane in his field has been converted into perennial sugarcane. During this period, the soil is continuously enriched as the farmer is able to concentrate most of his time and energy solely on im-

proving the organic content of the soil. The standing crop remains in a steady state economy, providing a sustainable yield of 40 tonnes per acre every year – the ideal of sustainable farming practices.

4. DESCRIPTION OF THE INSTITUTION RESPONSIBLE AND ITS ORGANISATIONAL ASPECTS

Suresh Desai is basically an institution in himself. Like all pioneers, he has worked on his own without much assistance from government officials or universities to perfect this system of organic farming of sugarcane.

Thereafter, he has sought to disseminate the modifications he has evolved to other farmers through the Organic Farmers Club. Today, the club has over 300 members who eagerly participate in discussions on his methods and further refinements of them where necessary. Desai says that approximately 1,500 acres of land in his area have already been converted to his system of water use to grow sugarcane.

The Organic Farmers Club is an informal institution and it is devoted to spreading the practice of organic agriculture among farmers in the area. Suresh Desai himself is one of the key individuals in the organic farming movement in the country initiated by **ARISE**, the federation of organic farming groups in India. He lectures frequently at organic farming workshops and schools on his method of water-efficient, organic sugarcane farming and has many followers.

5. PROBLEMS OR OBSTACLES ENCOUNTERED AND HOW THEY WERE OVERCOME

The greatest obstacle faced by Suresh Desai is the hold on farmers of the present package of practices which are based on intensive use of water in sugarcane farming. He says this association of sugarcane with water has become entrenched in the farmers' heads and only repeated demonstrations in farmers' fields that sugarcane can be raised without large quantities of water will eventually dislodge this completely erroneous idea from their heads.

6. EFFECTS OF THE PRACTICE/INNOVATIVE EXPERIENCE

The immediate effect of this practice is a dramatic reduction in the use of irrigation water (already a scarce commodity) of more than 75%. Conventional farmers irrigate their sugarcane fields 100%. Desai reduced the water requirement to 50% first and, by further innovations, brought it down another 25% through the neat redesigning of channels. This is not only bound to re-

duce costs to farmers, but the water saved can be allocated to farmers who have none or too little and for that reason are unable to do anything with their lands.

By the same measure of eliminating 50% of the water channels, Desai has created mulching beds for generating mulch and eventually humus. The result has been a major increase in soil quality and soil structure, and the creation of fresh living and operating space for earthworms and other species that help degrade organic matter. The consequence of that, in turn, has generated a situation in which the farmer is ready to question the necessity of adding any external inputs to the soil since he perceives his soil to be already rich and can be used for maintaining good crop production on a sustainable basis for several years.

By rejecting the use of chemicals and pesticides on his farm, Suresh Desai has shown that nature has adequate powers of regeneration and can raise plants on its own energy without the necessity of expensive (and environmentally damaging) inputs. An additional impact is that the air pollution from burning of the sugarcane crop residues in the field has been eliminated in this area and the ruinous practice of burning organic waste is eliminated.

7. SUITABILITY AND POSSIBILITY FOR UPSCALING

The modifications to the package of practices suggested by Suresh Desai are independent of scale and can be tried on small and large farms without any difficulty and with great benefit to all. The modifications, however, will work better on small farms as small farms, as a rule, are more efficiently managed than large farms. The construction of water channels is an art and can only be done effectively by hand.

In Israel, water is efficiently delivered to the root zone of plants through drip and sprinkler methods. These are expensive right from the inception, and require heavy advance capital availability, even though their efficiency is not doubted.

The Suresh Desai technique of reducing water channels and the raising of a 'bio-film' over the planted area is a cheaper, equally effective measure that can substitute for drip and sprinkler systems. The principal idea behind different methods to increase efficiency in water use is ultimately to provide adequate moisture at the roots. This can be done by repeatedly sending water through drip to the plant in small quantities. Or it can be sent through the alternative route proposed by Suresh Desai – enhancing the water-retention properties of the soil by several degrees.

The second alternative is achieved not only by increasing the organic content of the soil, but also by preventing water losses through evaporation by

simply covering the soil with organic material. Because of the known properties of rich organic soils, Desai's method is successful in spreading moisture through the soil, even to the root zones of plants two to three feet away.

8. SIGNIFICANCE FOR (AND IMPACT ON) POLICY-MAKING

The propagation of this method of organic farming for the raising of sugarcane, if made part of government policy, would help in better allocation of scarce resources and investments. It would help improve the productivity of sugarcane farms over the years as it would remove the element of uncertainty that presently dogs sugarcane production, largely due to the unpredictability of water supply itself as a result of the reliance of large water projects on good monsoon precipitation.

As the methods tried out and tested would improve sugarcane production in several farms, the total output of sugarcane in particular areas would not fall because overall efficiency would be improved. Most important, sugarcane would continue to be produced on a sustainable basis and resources assigned now to expensive, capital-intensive irrigation projects could instead be assigned elsewhere. Water from already constructed reservoirs could be assigned to farmers who do not get any of it, leading to enhanced employment opportunities.

9. POSSIBILITY AND SCOPE OF TRANSFERRING TO OTHER COMMUNITIES OR COUNTRIES

Suresh Desai decided to work out an alternative system that other farmers could also easily apply in their own fields. He has succeeded in evolving a new system which is basically a modification of the conventional system and which is easy to understand and replicate. There is therefore great scope for transfer of the method through direct learning and observation at Suresh Desai's farm. Desai himself has already organised several courses for interested farmers on his plot.

A simple manual which would describe the system of reduced channels would suffice to spread the technique among agricultural departments, extension centres and farming communities.