

## Workshop: Designing Roots

On July 2, 1997, AAI held a workshop titled "Designing Roots". A total of 30 participants from universities, forestry organizations and construction companies took part. In the morning, the idea of "designing roots" was introduced using a photo database. In the afternoon, participants tried hands-on work using actual equipment.

Even in dry sand areas which are constantly moved by wind, if you dig 1-2 m below the surface you will find small amounts of moisture. This subterranean moisture is relatively stable regardless of seasonal fluctuations in ground surface moisture. Trees naturally growing in this type of area extend their roots to this deep moist layer. However, even a drought-resistant seed can only just manage to sustain its life with this amount of water. In order to grow, there are different root systems at the 20-40 cm level which spread radially over distances of more than 10 m. These roots collect water efficiently from infrequent rain. In short, there is a division of labour: deep roots support life, and shallow roots play a role in growth. This is how trees in arid regions survive.

When planting trees artificially, the first task is to ensure survival of the plant by ensuring its roots reach the level characterized by stable moisture as soon as possible. We can leave considerations of growth to the parallel roots in the shallow level that collect natural seasonal precipitation. If possible, it is a good idea to water the plant from time to time. Anyway, the important thing is for roots to reach the deep layer as soon as possible. In this respect, how about growing long roots before planting? Fortunately, plant roots are highly adaptable. We have found out that it is possible to grow roots one or two meter in length, if we try.

The difficult bit is digging a hole sufficiently deep to plant such long roots. The ease with which sandy soil collapses makes the planting task even more difficult. However, even in these difficult circumstances there is a way to cope; namely by applying a device made from vacuum cleaners which employs two long tubes. The first fat tube, which covers the second thin tube, prevents the sandy soil from collapsing. The thin tube inside the fat tube vacuums sand out. The space between the two tubes acts as an air supply pipe. In early days of innovation, this device was only used in sandy soil, however, the technology has been improved and can now also be used in hard clay soil.

The basic idea for the technology was consolidated several years ago, and a number of experiments have been conducted in the Middle East, as a part of overseas assistance projects concerning arid agriculture and greening of the area. In May 1997, we held a workshop in cooperation with staff from the UAE's Afforestation Bureau which has been enthusiastically promoting plantation projects in desert areas. This was the basis of our workshop in July. A workshop is not just a one-way lecture. It is a gathering of people who interact with one another in order to find something new. We hope that this workshop does not end up with just one gathering, but will instead lead to the creation of networks among the participants that will help further examination and/or improvements in the field of root design. As a result, we hope that the idea of designing roots will spread in many directions to many people, leading to the improvement of afforestation technologies in arid areas, a reduction in labour and water use, and an increase in the number of self-standing trees.



**Digging device  
made from a  
vacuum  
cleaner**



**A scene from the workshop (in the afternoon)**

**Long-rooted and ordinarily-rooted saplings**

## Homepage “Root Design”

AAI and the NPO, Association SAHEL, have established a homepage titled ‘Root Design’, based on the experience of practical and sustainable tree plantation activities in the Middle East and the Sahel region. The concept of ‘Root Design’ was discussed in AAINews Vol. 12. This homepage contains more information gained afterwards as well.

From the 11th to 15th November, 2001 the sixth international root study symposium, “Roots: The Interface Between Plants and Mother Earth” was held at Nagoya International Conference Hall. On this occasion we took part in the poster presentation session and corporate exhibition where we presented the above homepage and exchanged information with root researchers from other countries.

Below is the summary of the homepage. Please have a look if you are interested.

### Root Design for Practical and Sustainable Afforestation

*- Our Trials and Findings in Arid Areas -*

URL : <http://www.open-resource.org/rootdesign/> **Appropriate Agriculture International Co. Ltd. & Association Sahel (NPO)**

#### Part I : Living in arid lands

A living life in the arid land is described especially in relation with trees, not by statistical data but by our actual experience in the area.

#### Part II : Root design - the basic concept

Why and how roots can be designed, and what kinds of possibilities are expected from the root designing?



#### Part III : From seeds to seedlings

**- living with trees in the nature -**

A practical guide of root design and afforestation, which helps to learn the necessary steps through experience in the field.

## Mini Series: Sequel to “Designing Roots”

### Part 1: Progress after the Workshop

As we mentioned in AAI News Vol. 12, we organized a workshop titled “ Designing roots” in the summer of 1997. In the morning session of the workshop, we introduced the notion of “Designing roots” using a photographic database. In the afternoon we had a practical session using actual tools. The combination of theory and practice was very well received by a large number of participants. There were many requests by academic journals and TV programmes for contributions.

We introduced the idea of “Designing roots” and actual activities in arid regions in the journals and symposiums listed in the table below. In addition, recently, a book titled “Root Design: food and environment created by roots,” was published by Japanese publishing named Yokendou, and this includes a section called “Greening of desert and root system growth” which summarizes our activities. Furthermore, our activities were broadcasted to the world through NHK’s satellite broadcasting.

Journal/TV Programme etc	Timing	Summary
“Root Research” Issue 6, Vol.3 Japanese Society for Root Research	Sept. 1997	Introduced the idea of designing roots, with the theme “new approach for tree planting in arid land.”
“Journal of the Japanese Society of Revegetation Technology, Issue 23, Vol 1 Technology Materials	Sept. 1997	Introduced AAI activities in the UAE, with the theme of introducing water saving tree planting techniques in arid area using long root cultivation.
“Green Age” Spring 1998, Japanese Greenery Research and Development Centre	Jan. 1998	With the theme of root system of trees for planting and nursing techniques, introduced nursing and planting technologies for long root saplings.
The Japanese Society of Revegetation Technology: Research Summary	April, 1998	Introduced our activities regarding long root cultivation and dew pit irrigation at a “sustainable tree planting” research committee meeting
NHK BS 2: Japan This Week	May, 1999	With a variety of footage, introduced “Sahel-no-mori (Forest of Sahel)” activities in Mali and applications of long root cultivation techniques.
Forest Consultant No 80, Society of Forestry Technicians	Jan. 2000	Introduced tree planting techniques in arid areas, focusing on the reality of many areas with highly limited materials.
Homepage of “Designing Roots”	Oct. 2001	“Living in arid area”, “Basics of thinking”, “From seeds to nature” at <a href="http://www.open-resource.org/rootdesign/index.html">http://www.open-resource.org/rootdesign/index.html</a>
Poster exhibition at the 6th Symposium of the International Society of Root Research	Nov. 2001	Introduced our activities and achievements at the poster exhibition “Root: Dynamic Interface Between Plant and the Earth.”
Root Design: Food and Environment Created by Roots, Yokendou	Nov. 2003	Root design: food and environment created by roots

As shown above, we have been widely introducing the concept of “Designing roots” making the most of various opportunities, while continuing with activities that aim to devise practical applications of this concept. What has become clear through these activities is that with normal saplings, one can achieve the same effect as long-rooted saplings, as long as there are the right conditions for roots to grow. In other words, if one plants normal saplings in the soil which allows their roots to grow to a certain depth, the same results can be obtained as with long-root saplings. In addition, we now have the possibility of planting very young saplings. When nursing long-rooted saplings, germination stimulated seeds are planted in plastic pots and then small saplings are transplanted to pipe-shaped pots. Even small saplings can be directly planted, as long as the selection of the planting location, pre-planting treatment and post-planting management are adequate and one can expect quite a high rate of survival.

Since the workshop, we continued to learn a significant amount through nursing long-rooted saplings and developing planting techniques, applying the techniques to afforestation activities in the field and dissemination of the results, as well as through trials and errors. In this new series, we will introduce a number of experiences in the field in development and dissemination of appropriate technology following planting of long-root saplings. We will also investigate the possibilities of application for afforestation activities in degraded lands around the world.

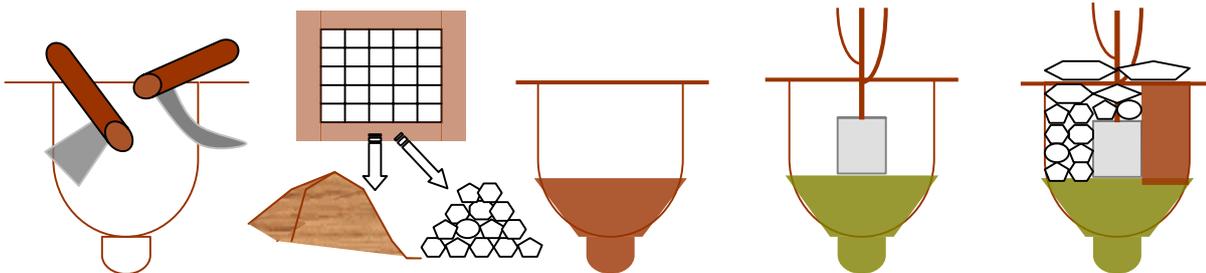
## Mini Series: Sequel to “Designing Roots”

### Part 2: Development of appropriate technology following long-root cultivation

In the northern edge of the desert in Sahel, there are deserts, dunes, stony plains and flat plains that are the remains of the bottom of dried lakes. Going a little further southward, one starts seeing farm land with crops that only require a small amount of annual rainfall, and seasonally used rangeland and woodland. However, many such farmlands and rangelands, which have been used repeatedly for millennia, are noticeably degraded having lost their topsoil. Tominian is in such an area. It is situated near the border with Burkina Faso and you can reach it from the Capital City Bamako, going on a major road to Mopti, leaving the Niger River at Ségou and go eastward through Bla and San. The NGO Saheru-no-Mori (Forest of Sahel) has been working in the town to restore natural vegetation and to promote afforestation and the greening of the area, making use of their experience with long-root cultivation.

The biggest success factor of long-root cultivation is how we can make roots reach permanently moist soil layers as quickly as possible. Once roots reach the layer, there is no need for watering and the plants will still keep growing. In Tominian, we are experimenting with the following method, attempting to attain similar effects as long roots, using ordinary saplings or young saplings.

- (1) Dig as deep a planting pit as possible using locally available tools
- (2) Divide the dug soil between fine soil and pebbles by sieving
- (3) Place fine soil mixed with livestock dung at the bottom of the hole
- (4) Pour ample amounts of water in the pit and plant the sapling
- (5) In order to ensure that water reaches the deep part of the pit, create vertical pebble layers and evaporation preventing mulch



By planting in this way, we can not only obtain the same growth efficiency as planting long root saplings, but also limited rain drops will be fed directly to the growth area of the root system without waste. In order to effectively trap rain water, it is important to observe detailed micro topographic conditions. Therefore, it is useful to mark areas that are even slightly lower than surrounding areas by walking around the planting area after rain. Sometimes there are no pebbles in soil dug from planting pits. It is important to identify places where pebbles and stones can be found. As we explained when we introduced the use of pebbles and stones in arid areas in AAI News Vol. 8, the use value of pebbles and stones for improving water permeability and mulching is very high. Rather than sticking to a particular technology, it is increasingly essential, in development assistance, to create processes to develop technologies appropriate for particular areas, by combining various technologies.



Digging a pit using locally available tools



Effective use of pebbles and stones



Sieving dug soil