Today we will be discussing the definition,

advantages, social and environmental

aspects of golden rice.

The outline of this module.

What is golden rice?

The advantages of golden rice.

The social and environmental

aspects of golden rice.

What are their learning outcomes?

At the end of this module,

students should be able to

explain the term golden rice.

Understand the advantages and

drawbacks of golden rice.

Highlight the social and

environmental aspects of golden rice.

What is golden rice?

Golden Rice is a variety of a rice,

which is our normal rice.

But it is produced from genetic engineering.

And it is biofortified

with through vitamin A.

So it is nothing but normal rice

which has biofortification of

vitamin A. Malnutrition and vitamin

A deficiency are very common in the

third world developing countries.

Vitamin A is a fat soluble vitamin.

This can be naturally obtained

from beta carotene,

and beta carotene is found in

green leafy vegetables as well

as yellow fruits or vegetables.

Beta carotene can also be obtained from

certain animal products like liver,

egg, yolk etc.

So why was rice chosen to be

bio fortified with vitamin A?

Rice is a staple food in many

developing regions in the world.

Unfortunately,

rice does not contain beta carotene and

therefore rice is not a source of vitamin A.

Rice provides about 80% of the daily caloric

intake of half the world's population.

What are the effects of vitamin A deficiency?

So if there is a lack of

vitamin A in your diet,

you can suffer from night blindness.

There is an increased susceptibility

to infections as well as cancer,anemia,

lack of red blood cells or hemoglobin.

There can be deterioration of the eye

tissue and also cardiovascular disease.

Nearly nine million children

die of malnutrition each year.

A large proportion of these

children die from common illnesses

that could have been avoided if

their nutrition was adequate.

The reduced immune competence

increases the morbidity and the

mortality rates of these children.

So if we can find a way in which

their diets can be made better,

then so many lives of these

children could have been saved.

The transgenic technology in Rice was

first applied by professor from

Switzerland and Germany.

So these are the two scientists who

thought of putting pro-vitamin A into rice.

What is the principle of

making this golden rice?

Golden Rice technology is based on the

principle that rice plants possessed the

whole machinery to synthesize beta carotene.

However, this machinery is turned

off in the grain endosperm.

It is fully active in the leaves.

That means every other part of the

rice plant can make beta carotene.

But in the seeds or in the endosperm,

it is missing.

By adding only two genes,

a plant phytoene synthase from daffodil,

and a bacterial phytoene desaturase

from the soil bacterium *Erwinia uredovora the*

pathway for making the beta

carotene can be turned on and now beta

carotene can accumulate in the grain.

Genes that are normally present

in the seed are genes which lead to

the formation of lycopene in the grain.

So there are these genes which

will finally lead to accumulation

of lycopene in the grain.

There is a lycopene cyclase that is always

found in the grain and this lycopene

cyclase will now convert the lycopene

into alpha carotene and beta carotene.

Now this lycopene that accumulates

in that rice will be converted into

beta carotene by lycopene cyclase.

Remember, lycopene cyclase is already

present in the rice golden rice,

one which was initially made produced

only 1.6 micrograms of carotene.

But if we see, the recommended daily

allowance of vitamin A is very high

and so persons would have to eat at

least 10 kilograms of rice per day

if Golden Rice-1 was used.

But this is not feasible.

So Golden Rice-1 was modified to give

us golden rice -2 .In golden rice -2 the phytoene synthase

gene was taken from Maze.

And now Golden rice -2 produces

35 micrograms of beta carotene.

So in June 2005,

further improvements were made to

this golden rice two and there is an

increased bio availability of provitamin,

A, vitamin E, iron,

zinc and improved protein quality.

So if you see this picture,

this is our normal white rice.

While this is our golden rice and

in this golden rice there is the

synthesis of that provitamin A

What are the benefits of using golden rice?

There are two kinds of benefits.

The health benefit directly there will

be a reduction in the vitamin A deficiency,

specially among women and children.

Also,

the per hectare yield of golden rice is

higher than the existing rice varieties,

so in that same area of the

field you will have increased

rice ears compared to when you

were growing normal rice.

The social and economic aspects

as far as health is concerned,

there can be allergy issues

or failure of performance.

Bio availability of vitamin A

is not completely efficient.

Environmental issues there can

be a loss of biodiversity,

so if everybody wants to grow golden rice,

our normal varieties of rice will

not be grown and those can be lost.

They can be a situation where

this golden rice can endanger

the existence of natural rice plants.
There can also be genetic contamination

of natural, global, staple food.

Cultural aspects some people prefer

to cultivate and eat only white

rice based on the traditional value

systems and spiritual beliefs.

So the golden color of rice may

not be acceptable by all people.

The recap at the end of the session

you should be able to answer this.

What are the genes transformed

to make a golden rice?

What are the social aspects

of using golden rice?

These are references students.