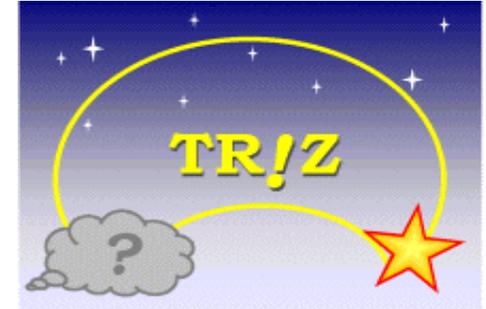


ETRIA TRIZ Future Conference 2011



**Problem Solving in Everyday Life:
On Methods and Tools
for Weeding (or Removing Weeds)**

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1. Introduction

- Problem of Removing Weeds, an example of everyday life problem solving.
 - Miyake wants to succeed his family's business of a gardening firm.
- Removing weeds is a labor work long done since ancient days.
A variety of agricultural tools and some machines have been developed.
- **But still needs much labor and time, at homes, at farms, at parks, etc.**
==> Reducing the labor for this will contribute much to social benefits.
- **Problem is not so simple but much complicated and diversified.**

Different places and situations: Home gardens, fields/rice fields, streets etc.

Different kinds of weeds and their growing situations,

Different kinds of tools and machines,

*** Differences in climate and differences in culture (in different countries)

==> Necessary to define/reorganize the problem, first.

Remove the weeds, please!

What's the Purpose?

Shall we dig the ground ?

Crops are still young?

What's the image of finishing?

Removing the weeds by the roots?

OK?
if no disturbance for walking?

What kind of place?

In the flowerbed of our garden.

How large area?

All through this rice field ?!

How is the ground?

No rain for over a week.

Are there crops/plants?

Which are the seedings of flowers?

Tools available?

A sickle

A powered rotary cutter

What kind of weeds?

Dokudami
(Korean houttuynia)

Status of the weeds?

Weeds grow dense.

I did the weeding a month ago

deep rooted?

Roots will remain alive.

2. Define the Problem of 'Removing Weeds'.

We should observe the problem from different aspects to grasp the overview.

2.1A Classification of the Purposes for Removing Weeds.

(A) Keep the scene beautiful.

(B) Clear the path, sight, etc. by removing the disturbing parts of weeds, bush, etc.

(C) **Remove the weeds which disturb the growth of crops.**

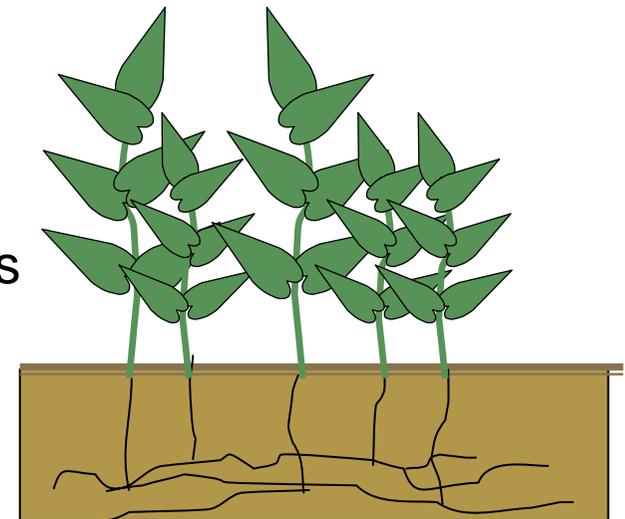
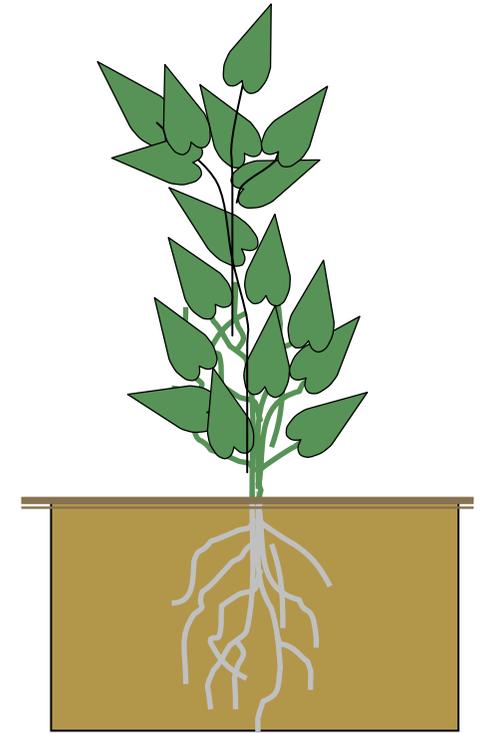
[Crops here include everything which must not be removed,
e.g., lawns, flowers, plants, trees, etc.]

(D) **Prepare for planting crops:** Remove weeds, dig/turn over the ground, etc.

(E) Cultivation: Remove disturbing rocks, trees, bushes, weeds, etc. for planting.

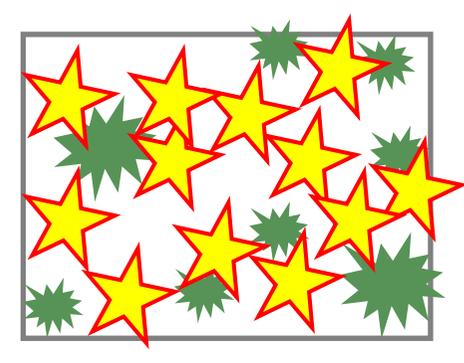
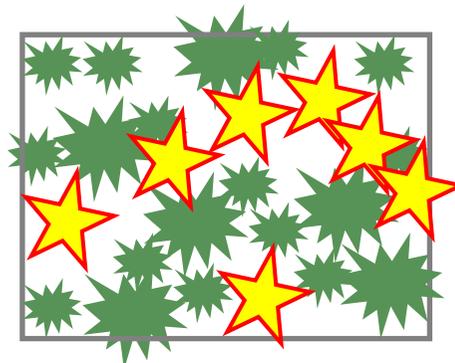
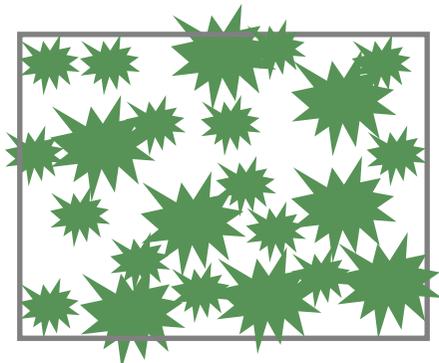
2.1B Classification of the Goal (Final image)

- (a) Remove the disturbing parts of weeds/bushes.
- (b) Remove larger weeds above the ground.
- (c) Removing weeds above the ground level, allowing most near/under ground parts remain alive.
- (d) Remove weeds by the root, but some kind of weeds having roots deep under the ground remain alive.
- (e) Remove the weeds by the root and remove roots deep under the ground.
- (f) Eliminate the possibility for weeds to grow.



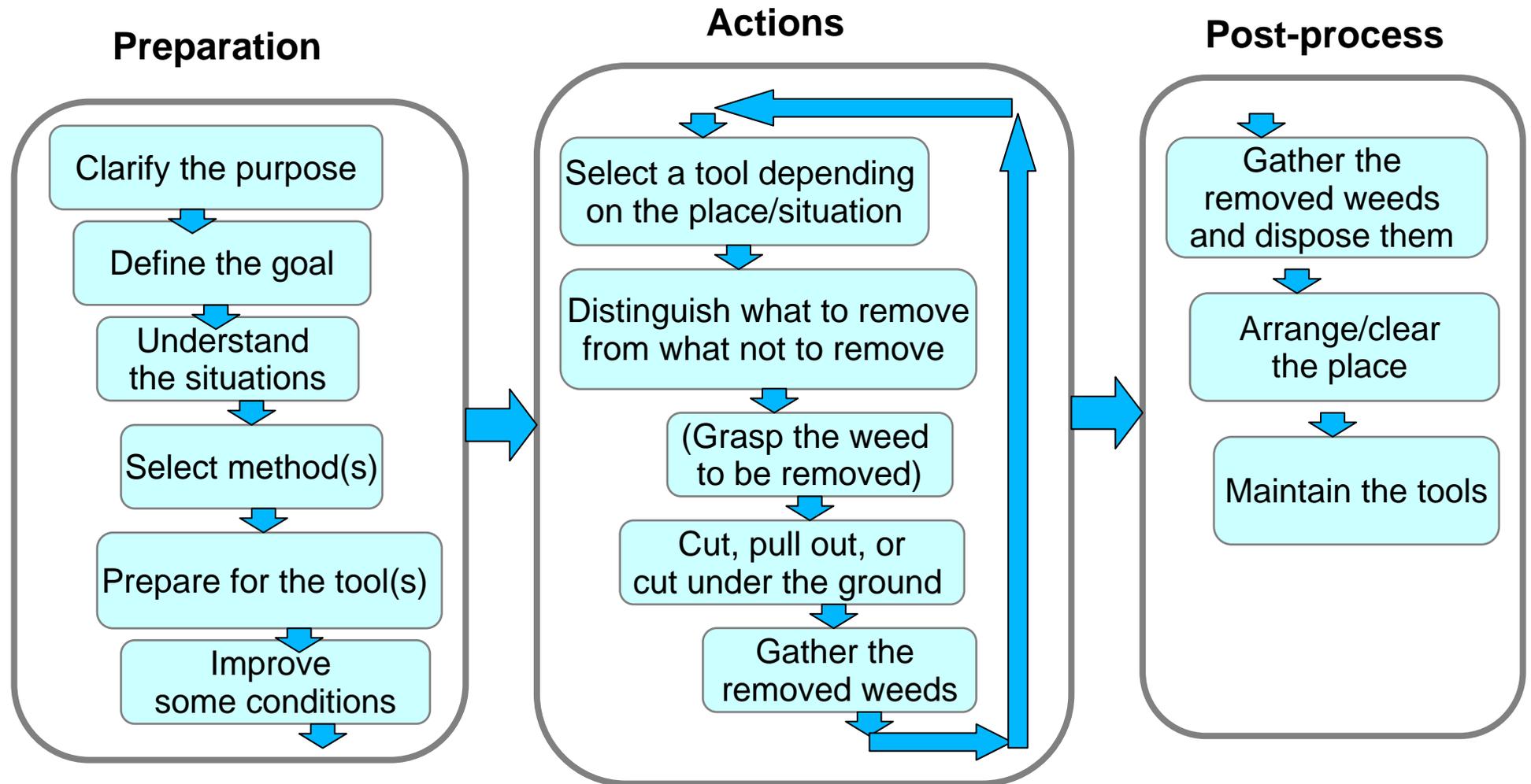
2.2 Different Situations: Place, Growth of Weeds, Relationship with Crops

- **Place:** At home (garden, flowerbed), Fields (rice field, farm), Town (park, road), etc.
- **Ground:** Hard/soft, with/without debris, slope/ flat, wasted land/cultivated land
- **Sorts of weeds:** Artemisia, silver grasses, dandelions, dokudami, etc.
- **Styles of growing:** Flat on the ground, spread, tall, gathered, densely, etc.
- **Forms of roots:** Straight down, spread under the ground, under-ground roots in every direction, under-ground rootstock,
- **Relationships with the existence of crops:**
("Crops" ★ = Everything we must not remove: e.g., farm crops, flower, plant, lawn, etc.)



3. Methods, Tools, and Machines for Removing Weeds

3.1 Processes for Removing Weeds



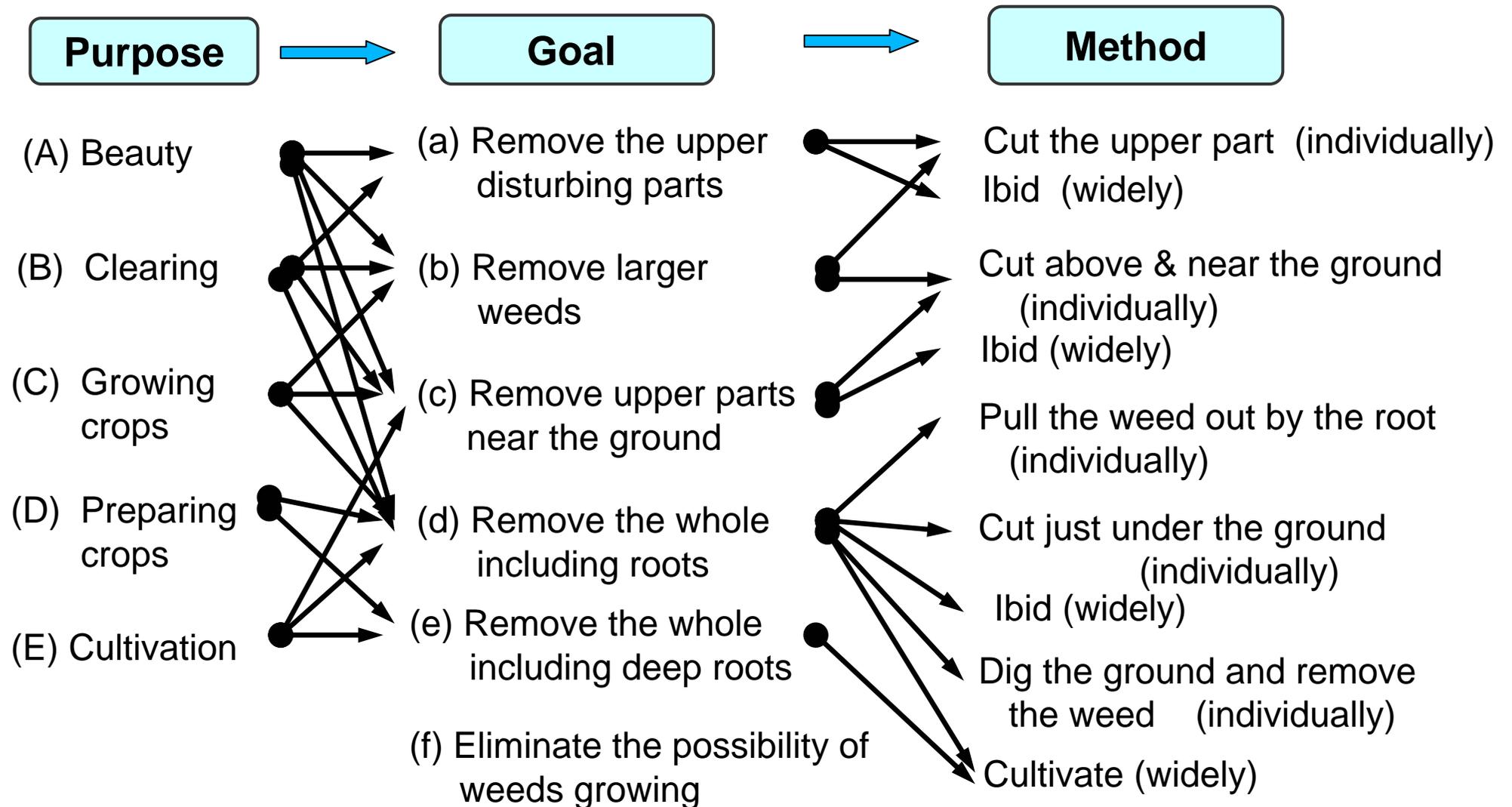
3.3 Classifying the methods in terms of tools and machines

Different aspects are necessary and effective:

- Purposes and goals of the usage of the tool/machine.
- Position of the weeds where the tool/machine intends to apply.
- **Action principle of the tool:** cut, break, pull, lift up, cultivate
- **Basic shape of the tool:** Single blade, double blades (scissors), saw teeth
- **Style of usage of the tool:** Single handed, double handed
- **Degree of mechanization:** Mechanical, Electric powered, pneumatic powered, etc.
- Effectiveness, efficiency, and labor in using the tools/machines

4. Reorganized Problem of Removing Weeds:

Purpose --> Goal --> Method --> Tool



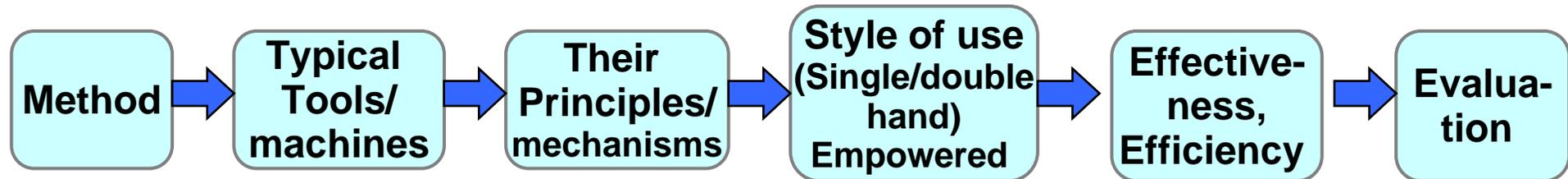
Removing Weeds: Methods, Tools, and Machines (1)

Method	Tool/ machine	Description, characteristics / remarks		Effectiveness
Preparation	Watering	Splash water beforehand to soften the ground	Effective for dry and hard ground	○
No tools	Hand	Grasp, pull up/pull out by the root, or break. (with gloves)	Can work selectively, efficient for soft ground.	Single hand ◎, Double hand ◎
Cut/ mow the upper parts	Sickle	Grasp the upper part of the weed and cut it below.	Variety of shapes and setting angles of the blade.	Single hand ◎, Double hand △
	Sickle with saw teeth	The blade has multiple teeth like a saw.	Can cut hard stems.	Single hand ○, Double hand △
	Powered rotary cutter	Circular disk with saw teeth is rotated rapidly to cut.	Powerful but dangerous when touches ground.	Powered, double hand◎
	Scissors	Cut with a pair of blades. Cut branches and stems near the root.	For trimming of flowers and plants. Limited use for weeds.	Single hand △, Double hand ○、
	Lawn mower	Cut grass and weeds at a certain height from the ground with roller blades.	Uniquely developed in the shape of the rotary blades. Limited usage in Japan	Double hand ○, electric powered ◎

Pull up by the root	(hook)	Hold the root stem with a Y-shaped hook and lift up the root to remove the whole.	Using a lever mechanism, weeds can be pulled up easily.	Single hand ☉
Cut just under the ground	(scraper)	With a blade set almost horizontally, the weed root is cut just (say 1 cm) below the ground surface,	Almost all kinds of weeds die, when the root stem is cut just below the ground.	Single hand☉, Double hand ☉
Dig the ground and remove the weed or turn the ground over	spade	Swing a blade down to dig the ground.	Digging/cultivating the ground is the main aim. Needs a lot of labour.	Single handΔ, Double hand ○
	fork shaped spade	The blade is split into 3 or 4 at the top.	Ibid (with less resistance from the ground)	Single handΔ, Double hand ○
	shovel	Insert a blade into the near-side ground to dig.	Ibid	Single handΔ, Double hand ○
	plough	Insert a blade into the near-side ground and push (or let cattle pull) it forward to dig the ground.	Ibid. (Need especially big power.)	Cattle/horseΔ, machine ○
	Power shovel	Dig ground in a way similar to spade or plough, and carry load.	Machine with pneumatic mechanism. Empowered.	Machine ○

Other	Burning of a field	Burn the field of dead weeds to exterminate harmful insects.	Used only in the fields/hills.	△
	Duck weeding method	Put water in the rice field, and grow duck chickens by their own feeding of water grasses.	Effective and useful without any human labor.	○

Removing Weeds: Methods and Tools: their evaluation



(Relatively) Highly Evaluated Methods/tools ☺

- Cut the root stem just below the ground surface (individually or widely) **"Scraper"**
- Pull up the weed root (individually) by using a lever mechanism. **"Hook"**
- Cut the upper parts of weeds (individually) with **"Sickle"** and (widely) with **"Rotary cutter"**.
- Cut grass and weeds at certain height leaving lawn grass alive thick (widely) with **"(Powered) Lawn mower"**.
- **"By hand(s) without tools"** is still efficient, for the purpose of removing weeds selectively among the crops and when the ground is soft (after rain, after splashing water, or naturally).

5. Conclusion: On the Methods for Removing Weeds:

- (1) Depending on the purpose, set the Goal image of finishing the job, and observe the situations from different aspects to decide the methods.
Place, area, growth of weeds, ground conditions, and existence of crops;
Whether to work either selectively & individually or widely.
- (2) Depending on the method, choose tool(s).
Choose effective tools, considering their principles and characteristics.
- (3) Unique emphasis in the present study, different from common usage:
Neither to cut the upper parts of the weeds,
Nor to pull the weeds out by the root, Nor to dig the root up,
But to cut the root stem just (say 1 cm) below the ground surface with "Scraper".
No need to pull the root up, no need to grasp the weeds while cutting.
Just leave the roots to die soon (for almost all kinds of weeds).
Can work widely with a scraper for double hand use and
individually & selectively with a scraper for single hand use.
- (4) This is a case study how to solve vaguely defined everyday life problems.**