


left: Rice field planted with strips of flowering plants along levees for ecological engineering (Photo: Leonardo V. Marquez)
right: Rice field planted with strips of flowering plants along levees for ecological engineering (Photo: Leonardo V. Marquez)

Ecological engineering for irrigated lowland rice ecosystem

Philippines

Ecological engineering for lowland rice ecosystem by promoting and planting of flower strips in rice fields

To counteract the negative impact of agricultural intensification, in particular the loss of biodiversity and ecosystem services, a more sustainable management of fields and surrounding habitats is required. Ecological engineering, i.e. the provision of habitats for beneficial arthropods, has recently gained considerable attraction as method to reduce pesticide inputs and enhance biological pest control provided by natural enemies. The concept of ecological engineering aims primarily at the regulation of pest species through the provision of habitats for their natural enemies, but other ecosystem services, such as pollination and cultural services, might also be enhanced with the same measures. One such measure which is also popular in agri-environmental schemes of temperate countries is the implementation of flower strips. In intensively managed irrigated rice production landscapes, biological pest control, pollination services and landscape aesthetics could also benefit from the establishment of flower strips on the bunds of rice fields.
Increase biodiversity in rice fields and provide habitats for beneficial organisms such as predators of rice pests (e.g. spiders) or parasitoids (e.g. hymenopteran parasites) in order to minimize the use of pesticides; additional side effect: landscape beautification - Collect seeds of flowering plants nearby (e.g. yellow flowering annuals such as Melampodium divaricatum) - Plant seeds in a nursery - Transplant after about a month in rice field levees with a strip size of 0.25 x 5 metres and a distance between flower strips of 5 metres (to enable access for farmers e.g. for fertilizer application) - Ask farmers not to spray insecticides - Trim flowers during fallow period of wet season - Water flowers during dry season of rice cropping - Re-establish flower strips after dry season if needed
Intensive lowland rice producing areas. This SLM technology is described for an irrigated rice ecosystem in the center of the island of Luzon in the Philippines, but has already been applied in other rice producing areas e.g. in Vietnam, and, with some adaptations, should be applicable to irrigated lowland rice production systems throughout Southeast Asia.

Location: Nueva Ecija
Region: Muñoz
Technology area: < 0.1 km2 (10 ha)
Conservation measure: vegetative
Stage of intervention: prevention of land degradation
Origin: Developed through experiments / research, recent (<10 years ago)
Land use type:
Cropland: Annual cropping
Climate: humid, tropics
WOCAT database reference: T_PHI065en
Related approach: Entertainment education for ecological engineering (A_VIE003en)
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Classification

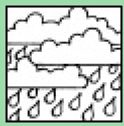
Land use problems:

- high use of pesticides leads to insect pest resistance to pesticides, pest outbreaks, low population of natural enemies and non-target organism, loss of biodiversity and health hazards to farmers. complete loss of forest caused poor water holding capacity of dams and water sheds, soil erosion and temperature rising. Intensive agriculture degraded soil condition and compromises sustainability of productive lands. Intensive agriculture also means more use of water resources, more chemical inputs and more pest pressure. (expert's point of view)
Pest problems (land user's point of view)

Land use

Annual cropping
full irrigation

Climate



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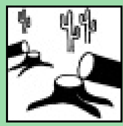
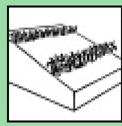
Degradation



Biological degradation: increase of pests / diseases, loss of predators

Conservation measure



Vegetative: Others (Annual flower strips)

Stage of intervention

- ■ Prevention
- ▒ Mitigation / Reduction
- □ Rehabilitation

Origin

- □ Land users initiative
- ■ Experiments / Research: recent (<10 years ago)
- □ Externally introduced

Level of technical knowledge

- ░ Agricultural advisor
- ░ Land user

Main causes of land degradation:
Direct causes - Human induced: deforestation / removal of natural vegetation (incl. forest fires)
Indirect causes: population pressure

Main technical functions:
- Biological pest control reduces pollution by agro-chemicals

Secondary technical functions:
- spatial arrangement and diversification of land use

Environment

Natural Environment

Average annual rainfall (mm)

- □ > 4000 mm
- □ 3000-4000 mm
- □ 2000-3000 mm
- ■ 1500-2000 mm
- □ 1000-1500 mm
- □ 750-1000 mm
- □ 500-750 mm
- □ 250-500 mm
- □ < 250 mm

Altitude (m a.s.l.)

- □ > 4000
- □ 3000-4000
- □ 2500-3000
- □ 2000-2500
- □ 1500-2000
- □ 1000-1500
- □ 500-1000
- □ 100-500
- ■ <100

Landform

- ■ plateau / plains
- □ ridges
- □ mountain slopes
- □ hill slopes
- □ footslopes
- □ valley floors

Slope (%)

- ■ flat
- □ gentle
- □ moderate
- □ rolling
- □ hilly
- □ steep
- □ very steep

Soil depth (cm)

- ■ 0-20
- □ 20-50
- □ 50-80
- □ 80-120
- □ >120

Growing season(s): 120 days(January to April), 120 days(June to September)
Soil texture: fine / heavy (clay)
Soil fertility: medium
Topsoil organic matter: low (<1%)

Ground water table: < 5 m
Availability of surface water: good
Water quality: for agricultural use only
Biodiversity: low

Tolerant of climatic extremes: heavy rainfall events (intensities and amount)
Sensitive to climatic extremes: floods, droughts / dry spells

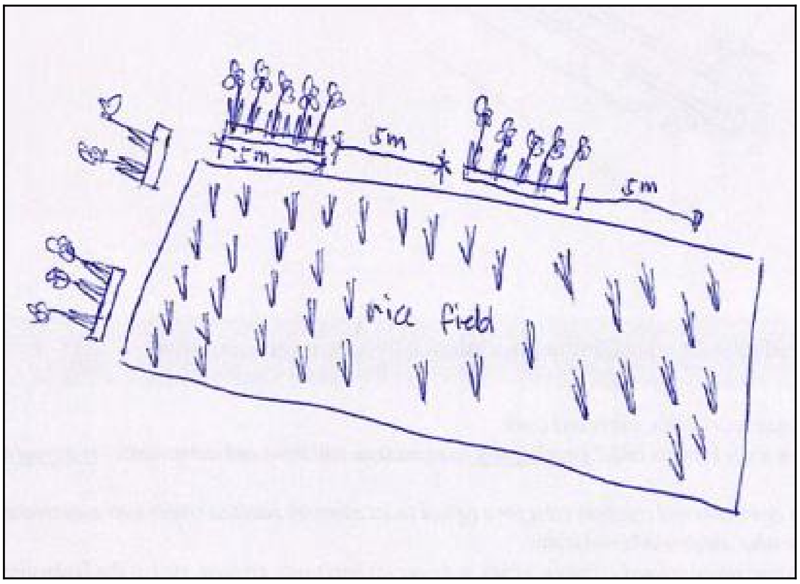
Human Environment

Cropland per household (ha)

- □ <0.5
- ■ 0.5-1
- □ 1-2
- □ 2-5
- □ 5-15
- □ 15-50
- □ 50-100
- □ 100-500
- □ 500-1,000
- □ 1,000-10,000
- □ >10,000

Land user: groups / community, Small scale land users, common / average land users, men and women
Population density: 200-500 persons/km2
Annual population growth: 1% - 2%
Land ownership: individual, titled
Land use rights: individual
Water use rights: communal (organised)
Relative level of wealth: average, which represents 70% of the land users; 50% of the total area is owned by average land users

Importance of off-farm income: > 50% of all income: Farming
Access to service and infrastructure: low: employment (eg off-farm), drinking water and sanitation, financial services; moderate: health, technical assistance, market, energy, roads & transport; high: education
Market orientation: mixed (subsistence and commercial)
Mechanization: manual labour, mechanised
Livestock grazing on cropland: no



Technical drawing

Fowering plants planted around rice field (Leonoardo V. Marquez)

Implementation activities, inputs and costs

Establishment activities

- Flowering plant seed collection
- Flowering plant nursery establishment
- Transplanting flowering plants

Establishment inputs and costs per ha

Inputs	Costs (US$)	% met by land user
Labour	90.00	%
Agricultural		
- fertilizer	4.00	%
- compost/manure	30.00	%
TOTAL	**124.00**	**0.00%**

Maintenance/recurrent activities

- Flowering plant maintenance, i.e. trimming, removal of volunteer seedlings out of the strips and thinning during cropping season. Watering and replacement in times of long drought fallow period

Maintenance/recurrent inputs and costs per ha per year

Inputs	Costs (US$)	% met by land user
Labour	40.00	%
TOTAL	**40.00**	**0.00%**

Remarks:

Assessment

Impacts of the Technology

Production and socio-economic benefits

\+ reduced expenses on agricultural inputs
\+ decreased workload

Production and socio-economic disadvantages

\+ increased labour constraints

Socio-cultural benefits

+++ improved health
\+ increased recreational opportunities

Socio-cultural disadvantages

Ecological benefits

+++ increased animal diversity
+++ increased plant diversity
+++ increased beneficial species
+++ increased / maintained habitat diversity
++ increased water quality
\+ increased biomass above ground C

Ecological disadvantages

Off-site benefits

Off-site disadvantages

Contribution to human well-being / livelihoods

++ Farmers in the area were looking for substitutes for using pesticides in their rice crop pest management, they are also aware to the adverse effect of chemicals to their health and to the environment. Farmers just need to implement management strategies in their rice because it is their livelihood. So when they use the technology of ecological engineering for low land rice and they dont use pesticide, they minimized their inputs and protect their health

Benefits /costs according to land user		
Benefits compared with costs	**short-term:**	**long-term:**
Establishment	positive	very positive
Maintenance / recurrent	slightly positive	positive

Acceptance / adoption:

90% of land user families (70 families; 90% of area) have implemented the technology with external material support.
10% of land user families (20 families; 10% of area) have implemented the technology voluntary.
There is moderate trend towards (growing) spontaneous adoption of the technology. adaptation for now is mainly by the project farmer cooperators and technicians (for demonstration)

Concluding statements

Strengths and → how to sustain/improve	Weaknesses and → how to overcome
enhances biodiversity in rice ecosystem → continue demonstration	Does not solve all problems with pests, i.e. pest outbreaks are still possible → develop integrated pest management, e.g. use pesticides only in emergency cases, or develop an insurance system for farmers
farmers save money by reducing pesticide use → present research study results to farmers	additional work for farmers → incorporate activities in traditional rice growing activities
ceasing or reducing pesticide use improves farmers' health → educate farmers in the harmful effects of pesticide use	