# RICE BASED FARMING SYSTEMS IN KERALA

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**Regional Agricultural Research Station**
**Kumarakom**

# Decline in Area and Production of Rice in Kerala

| Year | Area (lakh ha) | Production (lakh tons) | Productivity (kg/ha) |
|---|---|---|---|
| 1971-72 | 8.75 | 13.76 | 1544 |
| 1981-82 | 8.07 | 13.06 | 1660 |
| 1991-92 | 5.41 | 10.60 | 1959 |
| 2001-02 | 3.22 | 7.04 | 2182 |
| 2006-07 | 2.64 | 6.42 | 2435 |
| 2007-08 | 2.29 | 5.28 | 2308 |
| 2008-09 | 2.34 | 5.90 | 2520 |
| 209-10 | 2.34 | 5.98 | 2557 |
| 2010-11 | 2.13 | 5.28 | 2452 |

# RICE IN KERALA

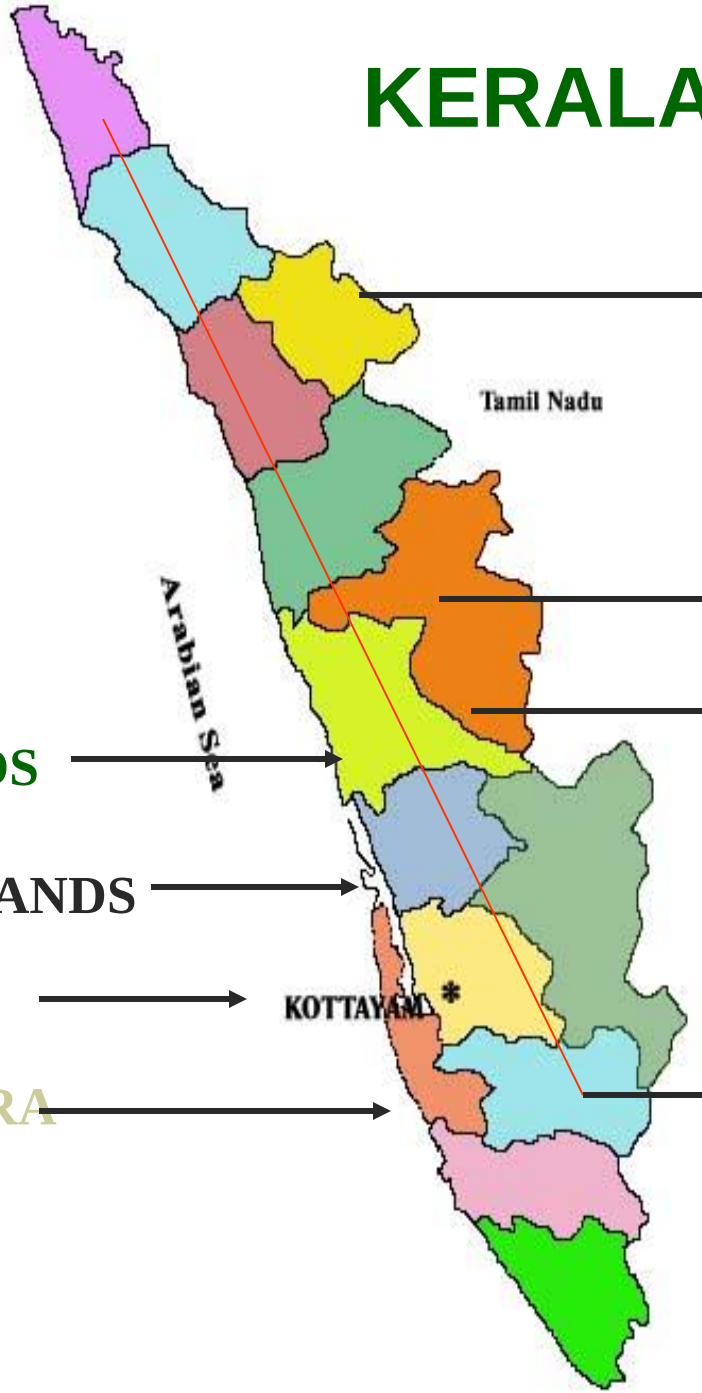
- Small farm size – less than 0.1 ha
- Mostly single season
- Income inadequate for livelihood
- Only seasonal engagement
- Part time and absentee farmers
- Fallow period 8 months

- Enhance productivity by 50%
- Increase income 3-4 fold
- Increase cropping intensity to 200%
- Render rice farming more organic and environment friendly
- Ensure year round engagement of land

# FARMING SYSTEM APPROACH

- Round the year utilization of rice fields
- Integrating compatible components
- Other crops
- Livestock
- Fishery
- Duck/Poultry

# KERALA




HIGH RANGE

PALAKKAD PLAINS

CHITTOOR BLACK SOIL

KOLE LANDS

POKKALI LANDS

KUTTANAD

ONATTUKARA

MIDLAND LATERITE & MALAYORAM

# Rice production systems of Kerala

| Rice ecosystems | Area in ha (91-92) | Percentage to total |
|---|---|---|
| Kuttanad | 38119 | 6.70 |
| Onattukara | 31031 | 5.45 |
| Pokkali | 4994 | 0.88 |
| Laterite Midland | 266838 | 46.89 |
| Malayoram | 103226 | 18.14 |
| Palakkad plains | 60342 | 10.60 |
| Black soil (Chittoor) | 37061 | 6.51 |
| High ranges | 27500 | 4.83 |

# HIGH RANGE RICE SYSTEM

- **Extent : 27000 ha**
- **Location: 800 – 1500 m above MSL**
- **Seasons:**

**Nancha (main) (May/June – Oct./Nov.)**

**Puncha (Dec./Jan. – April/May)**

# HIGH RANGE RICE SYSTEM

- **Situated at Elevations more than 800 m in the Wynadu plateau and Vattavada**
- **Extent 27500 ha**
- **Season extents the SW and NE monsoons (July – December)**
- **Varieties: Scented Jeerakasala and Gandhaka sala, and Uma, Athira.**

# High range - Rice based systems

# LATERITE MIDLAND AND MALAYORAM

- Extent : 3.7 lakh ha (1992)
- Seasons : Virippu, Mundakan Puncha
- Varieties : Short, medium and Photosensitive

# Mid land and Malayoram – Rice seasons

- Cropping pattern : Rice - Rice
- First crop (Virippu) : April/May – Sept./Oct.
- Second crop(Mundakan) : Aug./Sep. – Dec./Jan
- Yield range : 2860 – 8200 kg/ha
- Iron and aluminium toxicity limits crop production

# IRRIGATED RICE ECOSYSTEM

- Palakkad plains
- Periyar valley commands
- Chittoor black soils
- Irrigation ensured during the fag end of Mundakan and whole of Puncha

# IRRIGATED RICE SYSTEM

- Palakkad plains and chittur black soils
- Irrigated by water from Bharathapuzha
- Extent : 97500 ha
- Season : Virippu, Mundakan
- Varieties : HYV
- Known as second rice bowl of Kerala.

# Irrigated rice ecosystem – Palakkad plains

- Malampuzha the largest irrigation scheme
- One fifth of irrigation potential of Kerala
- **Valayar, Mangalam, Pothundi, Gayathry and**
- **Chittoorpuzha are others**
- **Extent : 60000 ha**

# IRRIGATED RICE ECOSYSTEM

## PALAKKAD PLAINS

- Double crop wetlands
- First crop (Virippu) : June/July – Sep./Oct.
- Second crop (Mundakan) : Oct./Nov. – Jan./Feb.
- HYV coverage more than 60%
- Short & Medium duration varieties for I crop
- Medium & Long duration varieties for II crop

# IRRIGATED RICE ECOSYSTEM – CHITTOOR BLACK SOILS

- Extent : 37000 ha
- Soils : Extension of black cotton soils
- Soil reaction : Neutral to alkaline (7 - 8.3)
- Texture : Sandy loam – Sandy clay loam
- Fertility : Medium – High in available N&P, low in K
- Yield : 4500 – 9000 kg/ha

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# ONATTUKARA RICE ECOSYSTEM

- **Extent : 28000 ha**
- **Crop sequence : Rice-Rice-Sesamum**
- **Soil texture : Sandy**
- **Soil reaction : Acidic**
- **Fertility status : Low in N, medium in available P & low in**

# ONATTUKARA RICE ECOSYSTEM

- **Virippu Season : April /May - September**
- **Variety : Short duration - Onam, Bhagya, Mattathriveni, Jyothi**
- **Seeding : By dibbling**
- **Weeding : Hoeing**
- **Yield : 1000-1200 kg/ha**


Onattukara - First crop at the time of harvest

# ONATTUKARA RICE ECOSYSTEM – II CROP

- **Season : Aug./Sept. – Dec./Jan.**
- **Seedling establishment. : Transplanting**
- **Variety : Ptb –20, Ptb-4, UR-19, Sagara**
- **Fertilizer dose : 40:20:20**

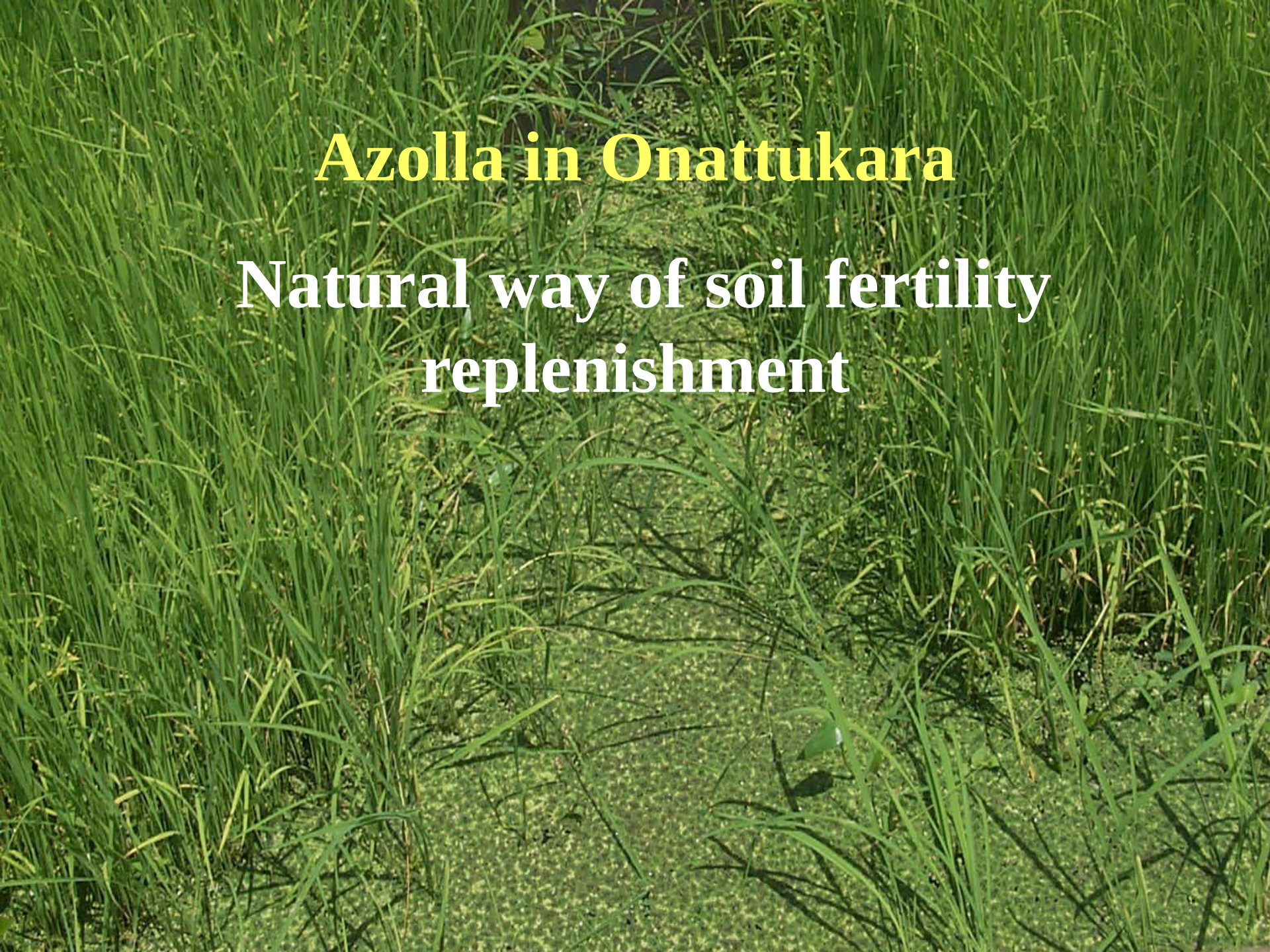
  **Application of P and K essential**

  **Organic manure addition essential**
- **Weeding : Hand weeding**
- **Yield : 1500- 2000 kg/ha**


Onattukara
Second crop Nursery


Onattukara
Land preparation for the second crop

# Onattukara – A poor second crop


Azolla in Onattukara
Natural way of soil fertility replenishment

# RICE – SESAMUM ROTATIONAL FARMING


Rice cowpea integration

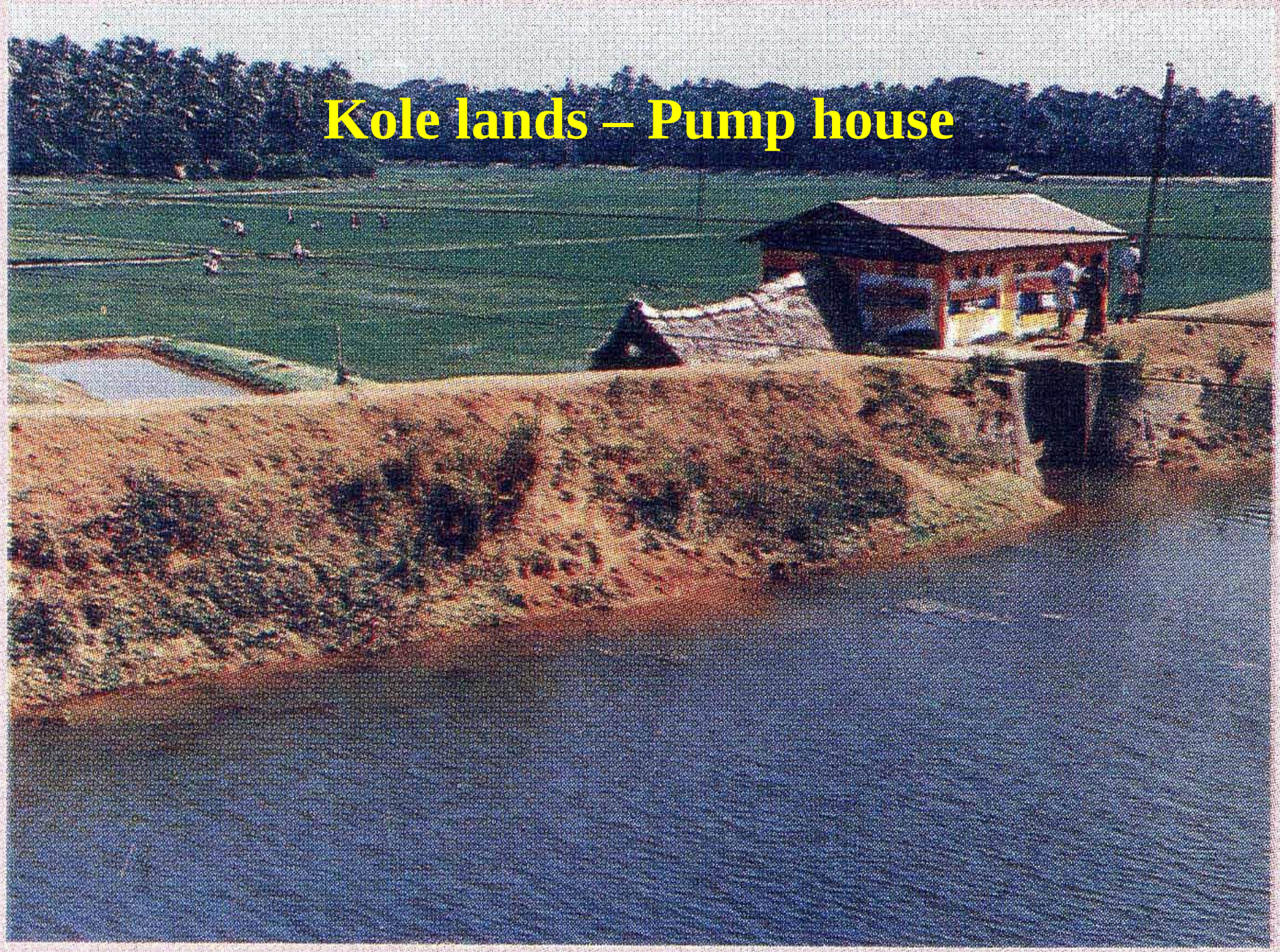

Rice-cucumber rotation

# Rice- Banana- Cassava System

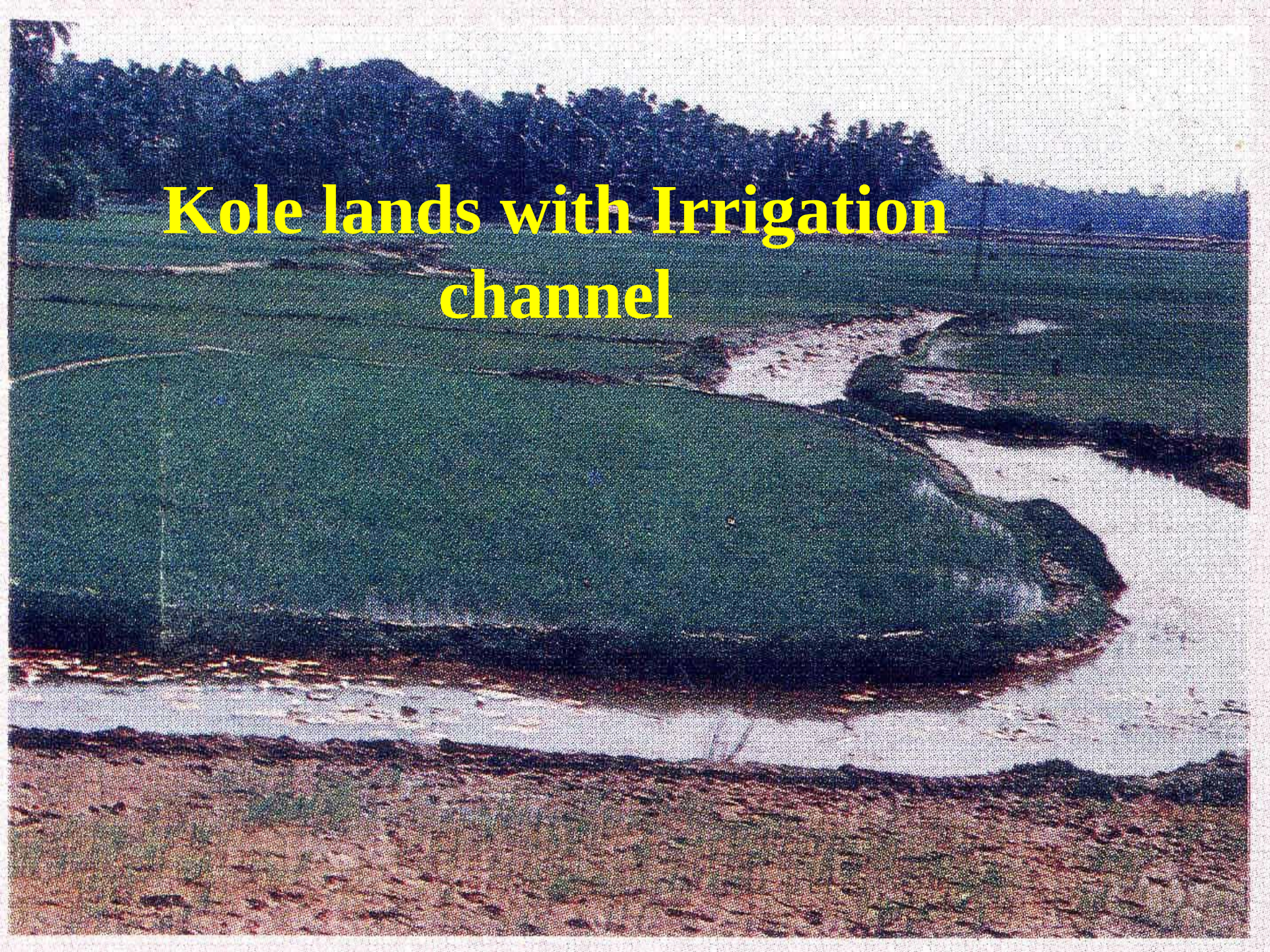
# KOLE LAND RICE ECOSYSTEM

- **Location : Trichur and Malappuram**
- **Extent : 13000 ha**
- **Cropping pattern : Rice – Rice (35%)**
  **Rice –Fallow (65%)**
- **Season : Jan.–May (Puncha)**
  **Aug.- Dec. (Mundakan)**

# Kole lands – Pump house



Kole lands with Irrigation Canal

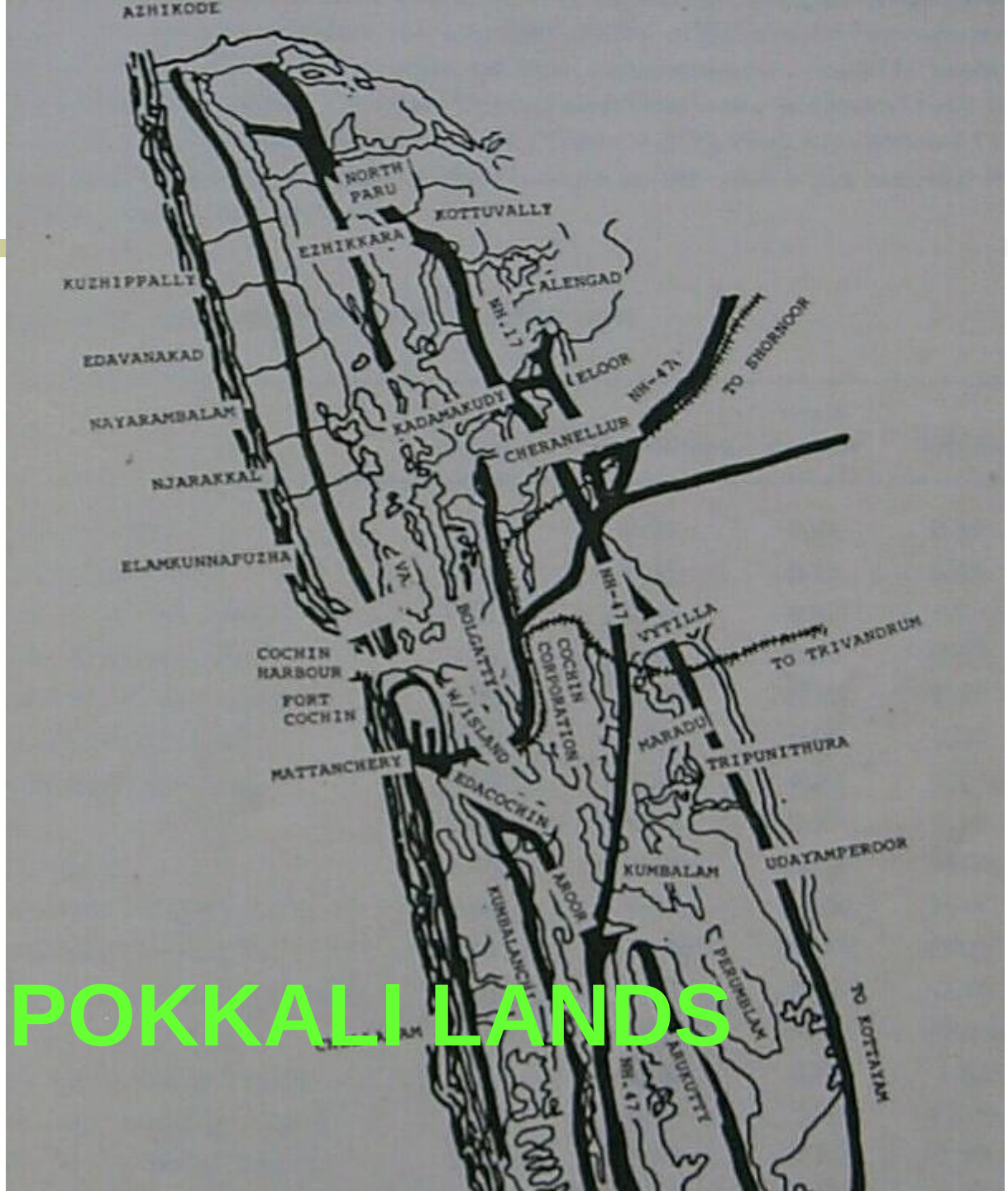

Kole lands with Irrigation channel

# KOLE LANDS

- Soil texture : Sandy loam to sandy clay
- Organic matter : 2.07 – 4.16
- Soil reaction : Acidic (pH 2.6 – 6.3)
- EC : 0.16 –15ds/m
- Yield : 4500-7500 kg/ ha.

# POKKALI RICE ECOSYSTEM

- Tidal wet lands of Kerala
- 24000 ha in the coastal area of Ernakulam, Alappuzha, Trichur and Kannur districts
- Tidal inundation & consequent salinity
- Rice & Prawn are rotationally grown
- Considered as sustainable system




# POKKALI LANDS


Pokkali fields
a view during the high saline phase

# POKKALI SOILS

- Basically acidic
- pH : 2.8 to 4.5
- Saline water inundation from October
- Salinity: 12 - 24 ds/m during summer
- Reclamation required for rice cultivation

# Two phases of Pokkali Agro-Ecosystem

**Low saline phase**

**June to November**

**High saline phase**

**December to May**

**Pokkali soils – mounds are necessary for reclamation of soil**

Seeds are packed in country baskets for soaking

Seed baskets ready for soaking

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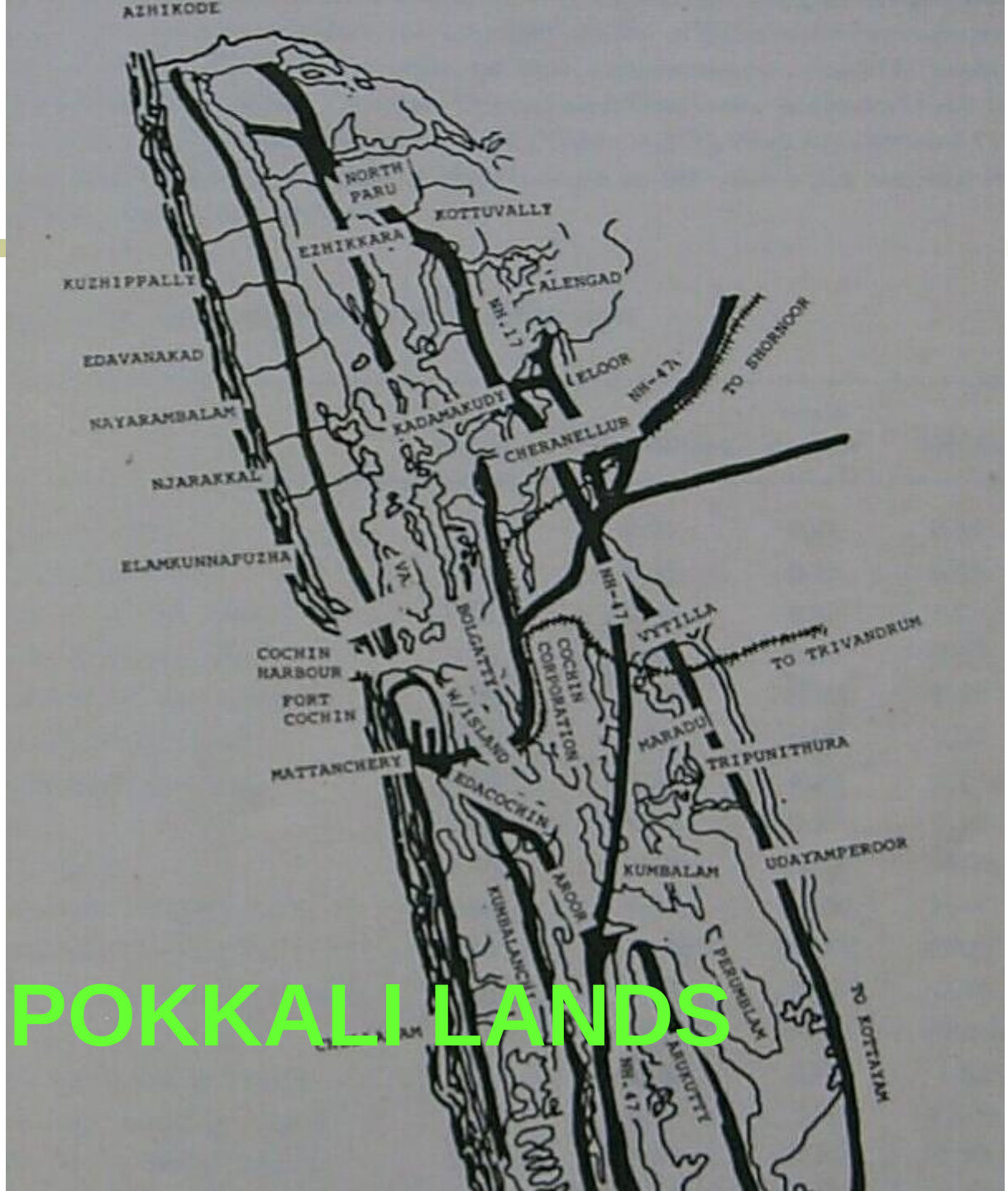


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**Damage due to floods – a regular occurrence in Pokkali fields**


Pokkali rice on mound tops ready for dismantling

Spreading operation in progress

# Luxuriant growth of the Pokkali rice

# Harvesting in knee deep water

# PRAWN CULTURE

- Prawn during saline phase
- Traditional practice - prawn filtration
- Prawn seeds are attracted & reared
- Prawn yield 300-1000kg/ha

# Income from prawn yields compensates the losses from rice cultivation

# Fish species found suitable

- Cyprinus carpio
- Oreochromis mossambicus
- Tricogaster pectoralis
- Chana striata
- Clarius batrachus

# Effect of rice fish integration on fish survival and yield

| Fish treatments | Survival % | | | Fish Yield kg/ ha | | |
|---|---|---|---|---|---|---|
| | 1999 | 2000 | Pooled | 1999 | 2000 | Pooled |
| Without fish | ---- | ---- | --- | --- | --- | --- |
| Male tilapia | 36.2 | 38.1 | 37.6 | 209.1 | 224.2 | 216.7 |
| Etroplus-1999 Rohu-2000 | 0.0 | 16.0 | 8.0 | 0.0 | 25.4 | 12.7 |
| CD (0.05) | 2.5 | 3.2 | 3.8 | 18.2 | 19.3 | 21.8 |

# Male tilapia

*Oreochromis mossambicus*

# Economic analysis of rice-fish-prawn integration in *Pokkali* fields

| Farming system | Expenditure (Rs/ha) | Yield (kg/ha) | Gross returns (Rs) | Net returns ( Rs.) | B:C ratio |
|---|---|---|---|---|---|
| Rice alone | 11450 | 3488 | 22672 | 11222 | 1.98 |
| Rice-fish | 17700 | 3488 (R)<br>216 (F) | 31346 | 13646 | 1.77 |
| Rice–fish -prawn | 46700 | 3488 (R)<br>216(F)<br>425(P) | 95090 | 48390 | 2.03 |

**Rice @ Rs. 6500/ ton**

**Fish @ Rs. 40/kg** **Prawn @ Rs. 150/ kg**

# Pokkali model

Rice during low saline phase

Rice-fish simultaneously

Prawn culture/prawn filtration rotationally

No way interfere with seasonal rhythm

Components well mingle

Accretion rather than depletion in soil fertility

Ecologically sound

Environment friendly

Socially acceptable

# RICE-FISH /PRAWN INTEGRATED FARMING


Sustainable, Economic, Eco-friendly

# KUTTANAD RICE ECOSYSTEM

- Deltaic formation of four river systems
- Location : 1 – 2.5 m below MSL
- Extent : 56000 ha
- Seasons : Main crop - Puncha

  (Oct./Nov. - Jan./Feb.)

  Additional Crop

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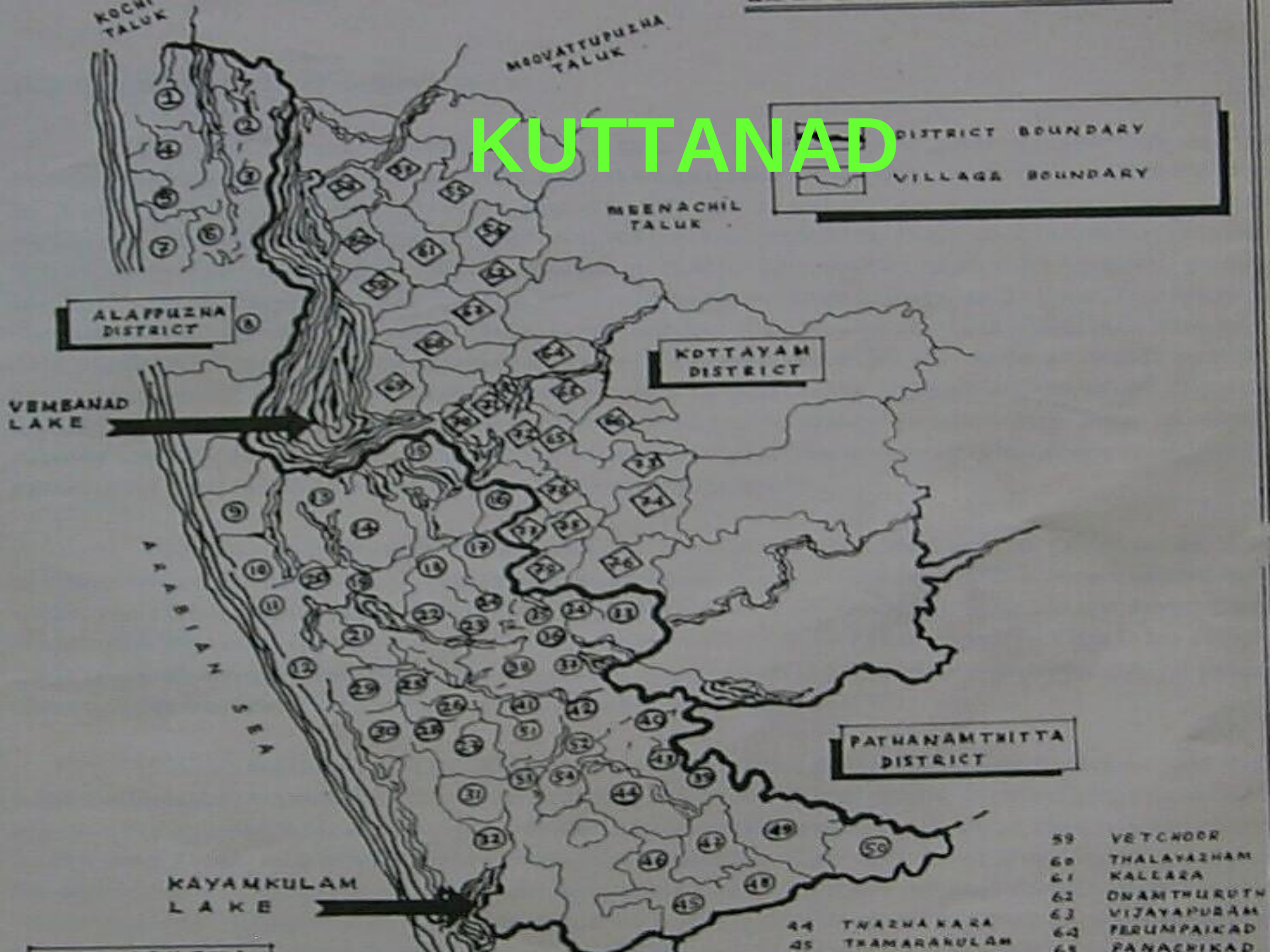
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# KUTTANAD SOILS

- **KARAPADAMS - 33,000 ha**
- **KAYAL LANDS - 13,000 ha**
- **KARI SOILS - 9,000 ha**

# KARAPPADOM SOILS

- River borne alluvial soils
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- Texture : Silty clay
- Soil reaction : Moderately acidic high salt content, and a fair amount of decomposing organic matter
- Salinity hazard
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- Heavy in texture, poorly aerated and ill-drained
- Pieces of wood seen embedded in the subsoil
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An overview of Kuttanad rice fields

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Low head axial flow pump (*Petti & para*)

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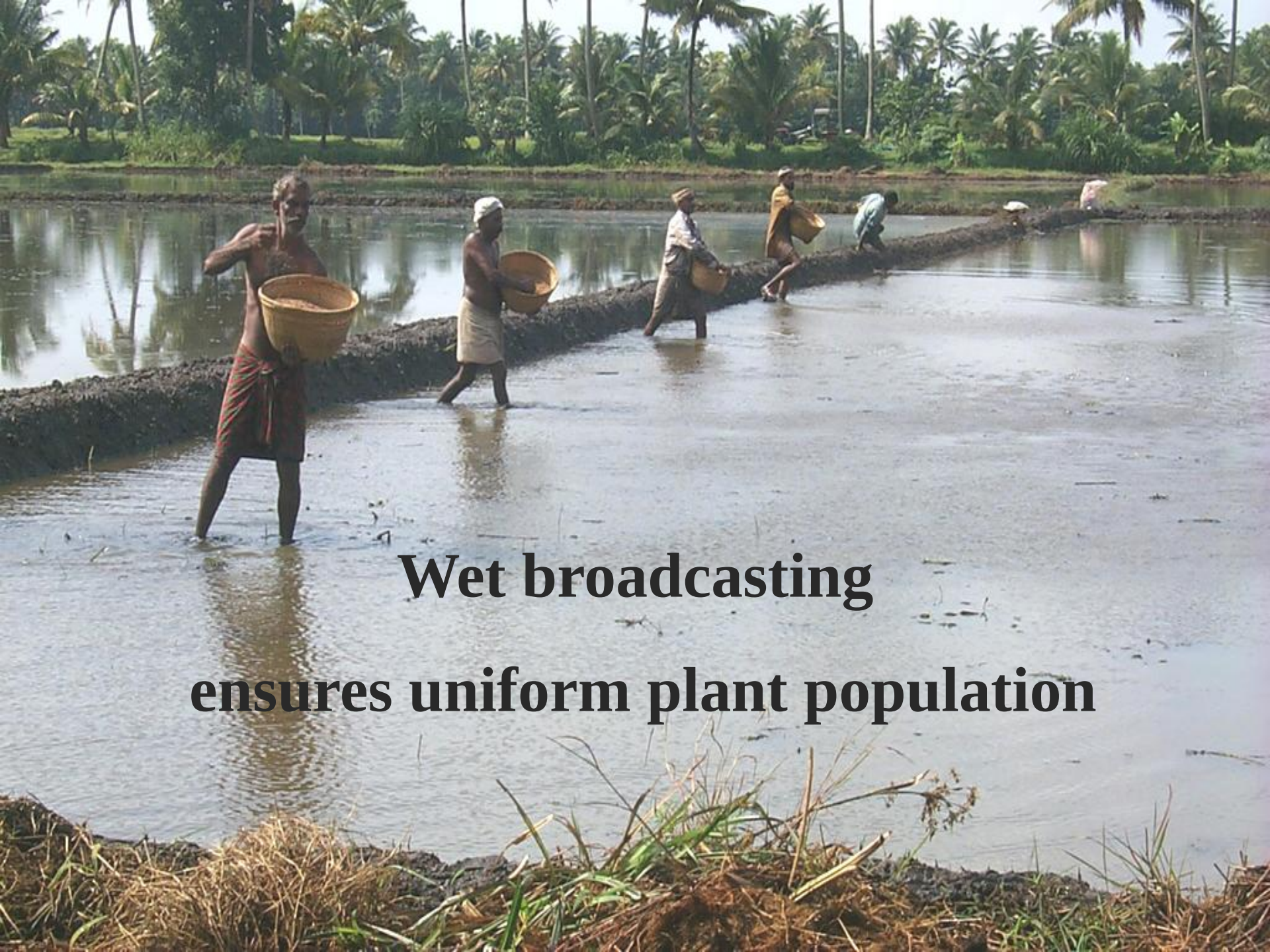

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Uneven land leveling results
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- Mostly single cropped
- Fallow period > 6 months
- Returns <25000/ acre
- Considerable scope of improvement by Farming system approach.

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**In two decades**

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**ORU NELLUM ORU MEENUM**

# *Cyprinus* – versatile species

**Ploughing and harrowing**


Grass carp- weed control

# Cost of production of paddy - before and after fish integration

| Sl. No. | Item | Before fish | | | | After Fish | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1995 (Puncha) | | 1996(Virippu) | | 1996(Puncha) | | 1997(Virippu) | |
| | | Cost(Rs) | | Cost(Rs) | | Cost(Rs) | | Cost(Rs) | |
| | | Material | Labour | Material | Labour | Material | Labour | Material | Labour |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Area of trial plot in acres | | 5.50 | | 5.50 | | 5.50 | | 3.00 | |
| | EXPENSES | | | | | | | | |
| 1 | a. Land preparation | 0 | 1483 | 0 | 2238 | 0 | 634 | 0 | 486 |
| | b. Bunding | 0 | 472 | 0 | 575 | 0 | 606 | 0 | 790 |
| 2 | Seed and sowing | 808 | 101 | 842 | 108 | 876 | 108 | 1021 | 115 |
| 3 | Weeding | 76 | 3198 | 76 | 3631 | 0 | 1460 | 0 | 3013 |
| 4 | Plant protection | 381 | 270 | 393 | 324 | 232 | 229 | 66 | 103 |
| 5 | Manuring/liming | 2008 | 298 | 2376 | 342 | 2200 | 319 | 2581 | 510 |
| 6 | Other Inputs | 346 | 894 | 371 | 1050 | 393 | 1062 | 0 | 1465 |
| 7 | Harvesting | 0 | 427 | 0 | 674 | 0 | 685 | 0 | 642 |
| | TOTAL | 3619 | 7143 | 4058 | 8942 | 3701 | 5103 | 3668 | 7124 |
| | INCOME | Qtls | (Rs) | Qtls | (Rs) | Qtls | (Rs) | Qtls | (Rs) |
| 1 | Paddy | 19 | 8967 | 28 | 14812 | 34 | 17144 | 35 | 17938 |
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| | TOTAL | 19 | 9338 | 28 | 15261 | 34 | 17369 | 35 | 18247 |
| | PROFIT | | (-)1405 | | 2289 | | 8599 | | 7490 |

# GIANT FRESH WATER PRAWN

Prawn Yield using local wet feeds – 937 kg/ha

Prawn yield using commercial feeds – 1519 kg/ha

In 230 days

Indicated the prospects of rice prawn integration

# Integrating other components

- Coconut, banana, yams and other crops on the bunds.
- Fish
- Ducks
- Buffaloe

# One acre paddy polder can additionally hold

- 2000 fish fingerlings
- 300 broiler ducks
- 1-2 buffaloes
- 20 coconut palms on the bund
- 40 banana plants
- 20-40 yams/cassava
- Single line fodder of 80m length.


Multi level integration of crops-livestock- fish-duck

# Complementary effects

- On land preparation
- Manuring
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# Zero tilled rice field after fish harvest  ready for planting

Fallow period 3 days

# Economic benefits

- Cost of production rice reduced by 17.6 percent
- Increase in yield up to 50%
- Multilevel integration increased the returns 3-4 fold.

# Ecological benefits

- **Reduction in use of agricultural chemicals**
- **Improvements in soil conditions**
- **Recycling of agricultural wastes**
- **Perceptible improvement in soil biological properties.**

# CONCLUSIONS

- In wetlands rice should be the pivotal crop
- Multiple cropping of rice as monoculture systems are not sustainable.
- Use of increased external inputs year after year erode the biodiversity base and upset ecological balance.
- Shift to biodiversity based multi commodity enterprises suited to local agro ecological conditions can perform better.
- Such systems can significantly reduce high energy inputs and cost of production.
- Farming system approach is capable of reducing carbon emission and sequestering of carbon in soils and plants

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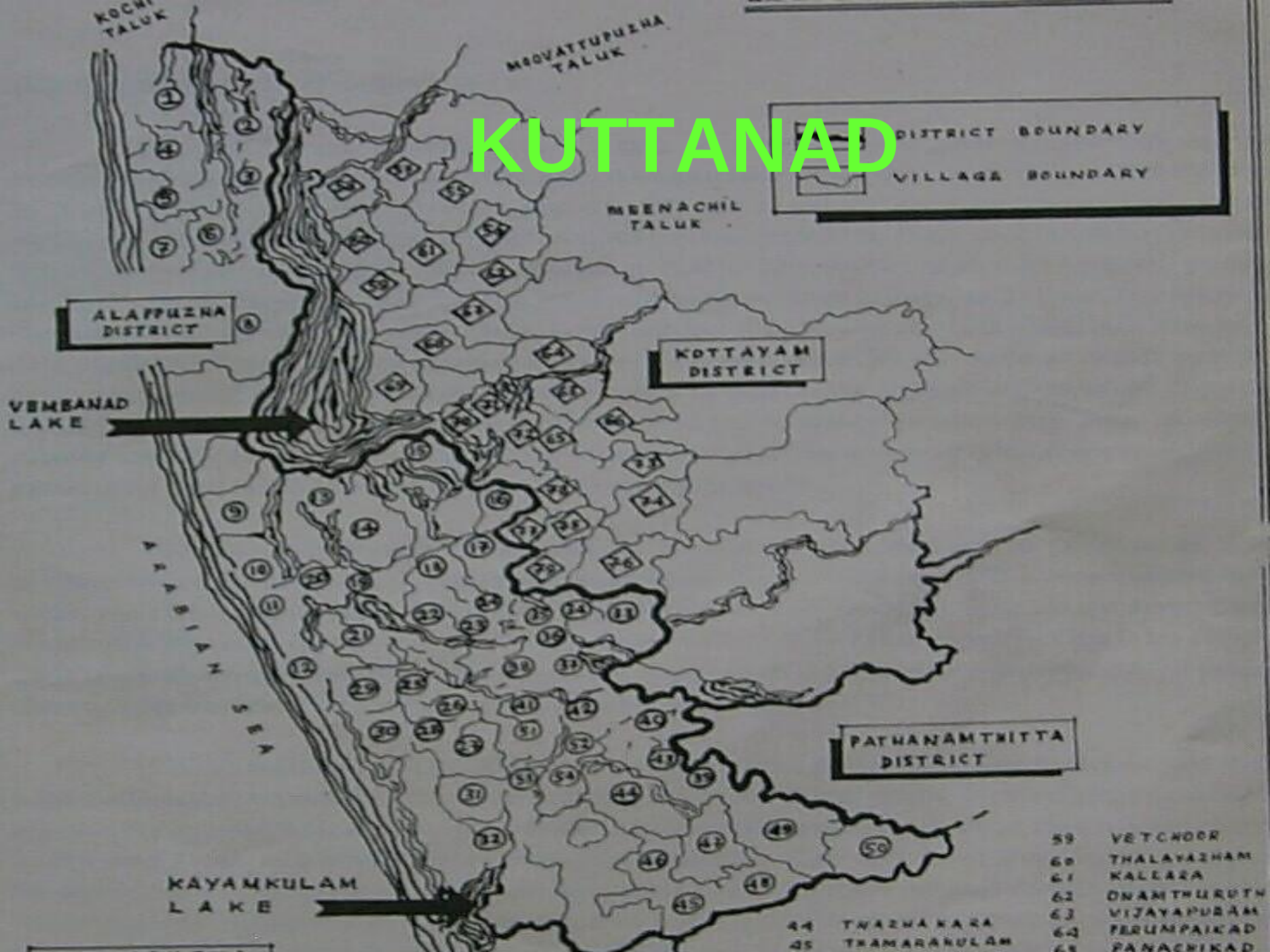
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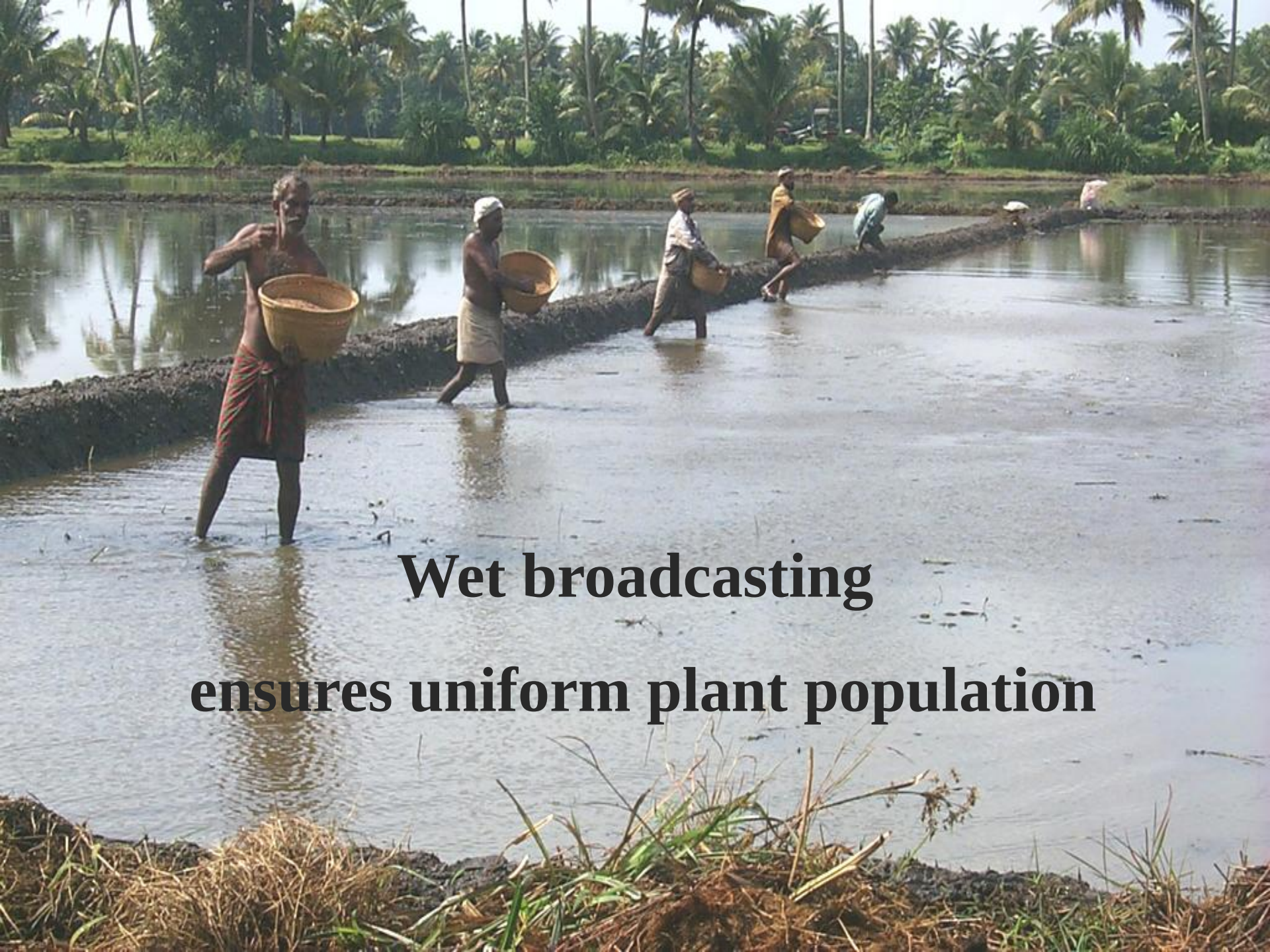

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- **Recycling of agricultural wastes**
- **Perceptible improvement in soil biological properties.**

# CONCLUSIONS

- In wetlands rice should be the pivotal crop
- Multiple cropping of rice as monoculture systems are not sustainable.
- Use of increased external inputs year after year erode the biodiversity base and upset ecological balance.
- Shift to biodiversity based multi commodity enterprises suited to local agro ecological conditions can perform better.
- Such systems can significantly reduce high energy inputs and cost of production.
- Farming system approach is capable of reducing carbon emission and sequestering of carbon in soils and plants