INCREASING THE PRODUCTIVITY AND EFFICIENCY IN RICE PRODUCTION WITH THE RICECHECK SYSTEM

Nguu Van Nguyen
Executive Secretary, International Rice Commission
Food and Agriculture Organization of the United Nations

International Year of Rice
2004

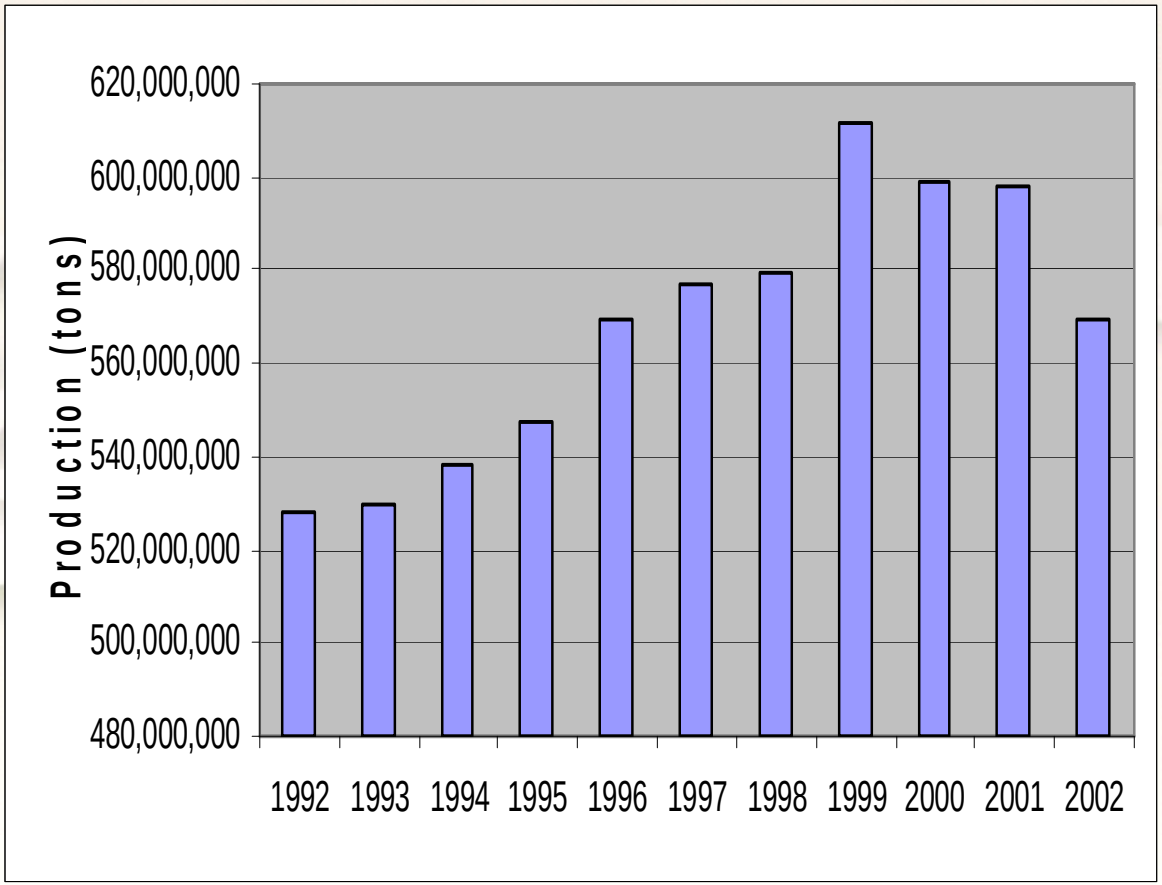
rice is life

Importance of Rice and Rice systems

- Rice is the staple food for more than half of the world population
- Rice systems provide incomes and employment to millions of households
- Rice systems are important for enhancing nutrition and sustainable development

rice is life

RECENT EVOLUTION IN GLOBAL RICE PRODUCTION



International Year of Rice
2004

rice is life

Issues of Rice-based Systems

- Diminishing land and water resources
- Increased pressures of pest and diseases
- Declining soil fertility
- Poverty in rice producing population

Need efforts to enhance the productivity and efficiency in rice production

rice is life

RiceCheck system for Increasing Productivity and Efficiency

Outline of Presentation

- Yield Gap in Irrigated Rice Production
- Technologies for Managing Rice Crops and Systems for their Dissemination
- FAO Programme on Development and Dissemination of RiceCheck System
- Conclusions

rice is life

THE YIELD GAP IN IRRIGATED RICE PRODUCTION

Yield Potential in Rice

- Yield potential of traditional *Indica* varieties = 5 t/ha
- *Japonica* x *Indica* breeding in 1950s
- Yield potential of High-yielding *Indica* varieties = 10 t/ha in IR8
- Yield potential of High-yielding *Japonica* varieties = 15 t/ha in YRL
- Yield potential of hybrid varieties = 18 t/ha in II-32A/Ming86 hybrid

rice is life

THE YIELD GAP IN IRRIGATED RICE PRODUCTION

Major Observations of the Expert Consultation in 2000

- **There is still a large yield gap in irrigated rice production today**
- **The closing of this yield gap could increase substantially rice production without further investment in land and water development**

rice is life

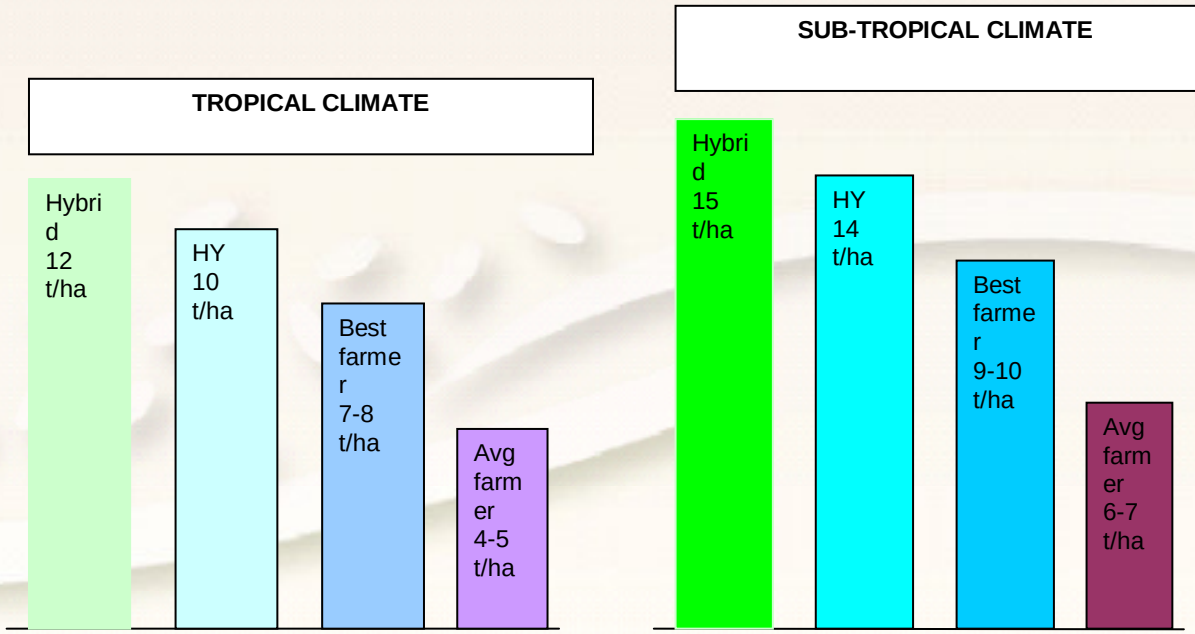


Fig. 1 Graphical expression of yield gaps in irrigated rice production under tropical (left) and temperate (right) climate areas

rice is life

THE TECHNOLOGIES FOR MANAGING RICE CROPS AND THE SYSTEMS FOR THEIR DISSEMINATION

- The Asian packages of production technologies in 1970s and early 1980s
- The integrated pest management (IPM) system in mid-1980s and associated systems
- The System of Rice Intensification in Madagascar in early 1980s
- The Marbrouk-4 System in Egypt in 1985
- The P-7 package in Burkina Faso in 1992-93
- The WARDA Rice-Integrated Crop Management System in 1995, and
- The RiceCheck system in Australia in 1986

rice is life

THE TECHNOLOGIES FOR MANAGING RICE CROPS AND THE SYSTEMS FOR THEIR DISSEMINATION

BOX 1: Package of Production Technologies for Transplanted Rice in the Philippines in the 1970s Cardenas et.al, 1980)

- Application of Basal Fertilizer: Broadcast approximately 3/4 of the nitrogen fertilizer recommended in the form of urea 45% N uniformly in the field; harrow the field to puddle thoroughly in preparation for transplanting.
- Transplanting: Use 18-day-old seedlings and soak the roots in 12% concentration of carbofuran solution for 12 to 24 hours before transplanting; transplant 2-3 seedlings/hill at 20 cm x 20 cm spacing in straight rows.
- 1-2 DAT: Apply carbofuran granules at 0.5 kg a.i./ha or diazinon at 1.0 kg a.i./ha
- 4-5 DAT: Apply 0.8 kg a.i./ha 2.4 D IPE G 3.2% if 2-3 cm depth of water is present in the paddy
- 6-8 DAT: If field is flooded and 2,4 D IPE G 3.2% cannot be applied at 4-5 DAT, apply butachlor or benthiocarb at rate of 1.5 kg a.i./ha
- 15-20 DAT: Spray 2,4 D IPE EC 48% or MCPA liquid herbicide at 0.8 kg a.i./ha if granular herbicide cannot be applied; handweeding of field if necessary to remove weeds that escaped herbicide treatment.
- 20 DAT: Broadcast carbofuran granules at 0.5 kg a.i./ha or 1.0 kg a.i./ha diazinon if there is standing water in the paddy or spray insecticides to control stemborers and green leafhoppers.
- 20-25 DAT: Broadcast 100 kgs ammonium sulfate 21% N as topdressing at panicle initiation.
- 20-45 DAT: If there is 10% or more deadheart, apply 0.5 kg a.i./ha of carbufuran.
- 45 DAT: If there is 10% or more deadheart, apply 1.0 kg a.i./ha of carbufuran.
- 50-55 DAT: At milk stage, spray insecticides to control rice bugs if there are more than 5 insect/m^2 .
- 85-90 DAT: Harvest the crop.

rice is life

THE TECHNOLOGIES FOR MANAGING RICE CROPS AND THE SYSTEMS FOR THEIR DISSEMINATION

Results of Application

- **Yield increase: Growth rate of Asian rice yield**
  - **1970s: 1.88% per year**
  - **1980s: 2.86% per year**
- **Negative effects:**
  - **Pollution due to applied pesticides**
  - **New insect pests (e.g., brown planthopper type 3) and insect pest pressure**
  - **Decrease in soil fertility, especially minor elements, e.g. zinc**

rice is life

THE TECHNOLOGIES FOR MANAGING RICE CROPS AND THE SYSTEMS FOR THEIR DISSEMINATION

IPM system

- Developed and disseminated in 1986
- Teaches farmers to observe the following in their development of strategies for insect pest management
  - the insect population
  - the condition of the crop and the damage caused by the insects
  - the natural enemies of the insects
- Started in Indonesia and widely adopted in Asia

rice is life

THE TECHNOLOGIES FOR MANAGING RICE CROPS AND THE SYSTEMS FOR THEIR DISSEMINATION

Results of IPM application

- Quantity of pesticides applied in rice production was greatly reduced, especially in Indonesia
- Less pesticide pollution, and more growth of agricultural biodiversity
- Promotion of the development of INM systems
- Initially developed for insect pest management, but has expanded to cover diseases, weed and community pests at present
- **Cannot sustain yield growth**

rice is life

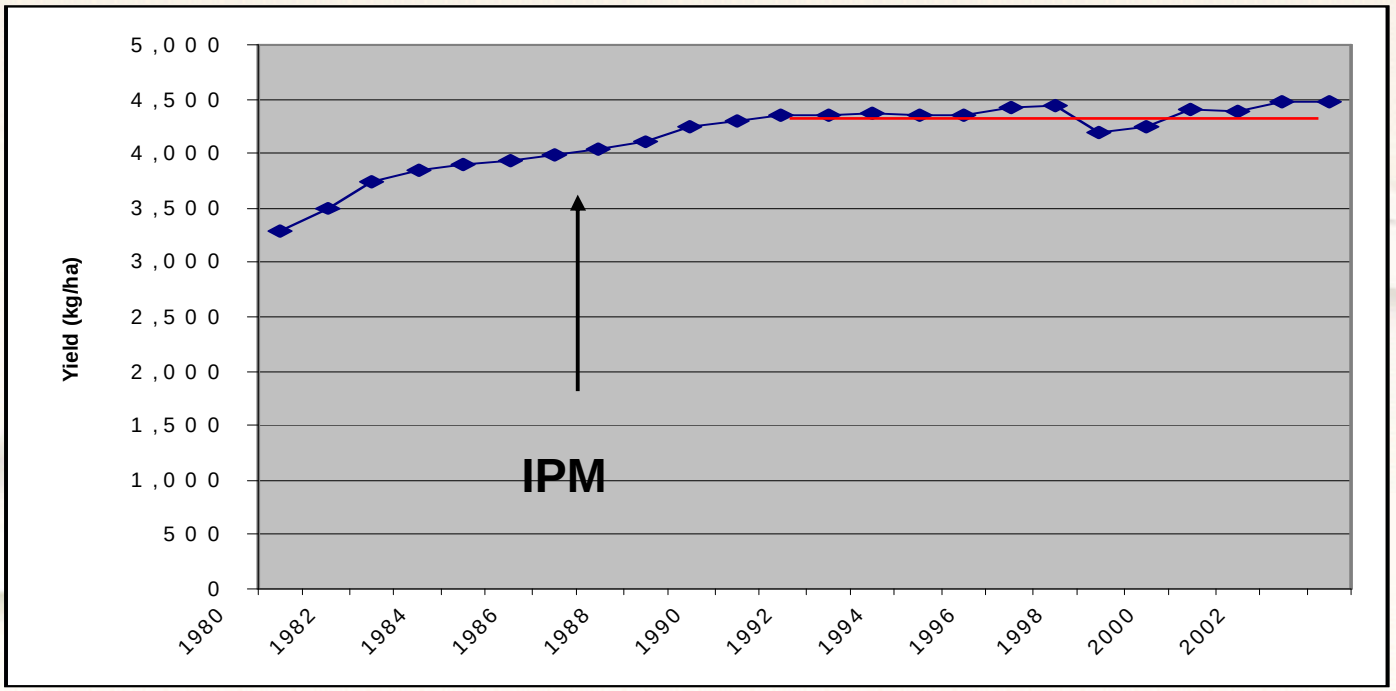


Figure 2. Indonesian rice yield, 1980-2002 (FAOSTAT)

rice is life

THE TECHNOLOGIES FOR MANAGING RICE CROPS AND THE SYSTEMS FOR THEIR DISSEMINATION

SRI system

- Developed and disseminated in Madagascar in 1986
- Promote the application of the following practices:
  - Young seedlings (<10 days old)
  - Wide spacing (25 x 25 cm or wider, up to 50cm x 50cm)
  - Intermittent irrigation – field should not be kept flooded
  - Application of organic fertilizer as much as possible
  - Intensive hand/mechanical weed control
- Recently promoted by a number of scientists and non-governmental organizations
- *Recently evaluated by IRRI and IWMI*

rice is life

THE TECHNOLOGIES FOR MANAGING RICE CROPS AND THE SYSTEMS FOR THEIR DISSEMINATION

SRI system

- **In Madagascar:** Limited adoption without significant effect on yield
- **Recently reported by its proponents:** SRI produced high upland yield: 7 t/ha under rainfed condition in Philippines, up to 12-21 t/ha under irrigated conditions
- ***Evaluation by IRRI:*** *SRI and Conventional Management system produced equal yields*
- **Major point of scientific contention:** Yields reported for SRI, some even with traditional varieties, are higher than the predicted yield potential of HYV (10 t/ha for *Indica*, 15/ha for *Japonica*) and hybrid varieties (18 t/ha)

rice is life

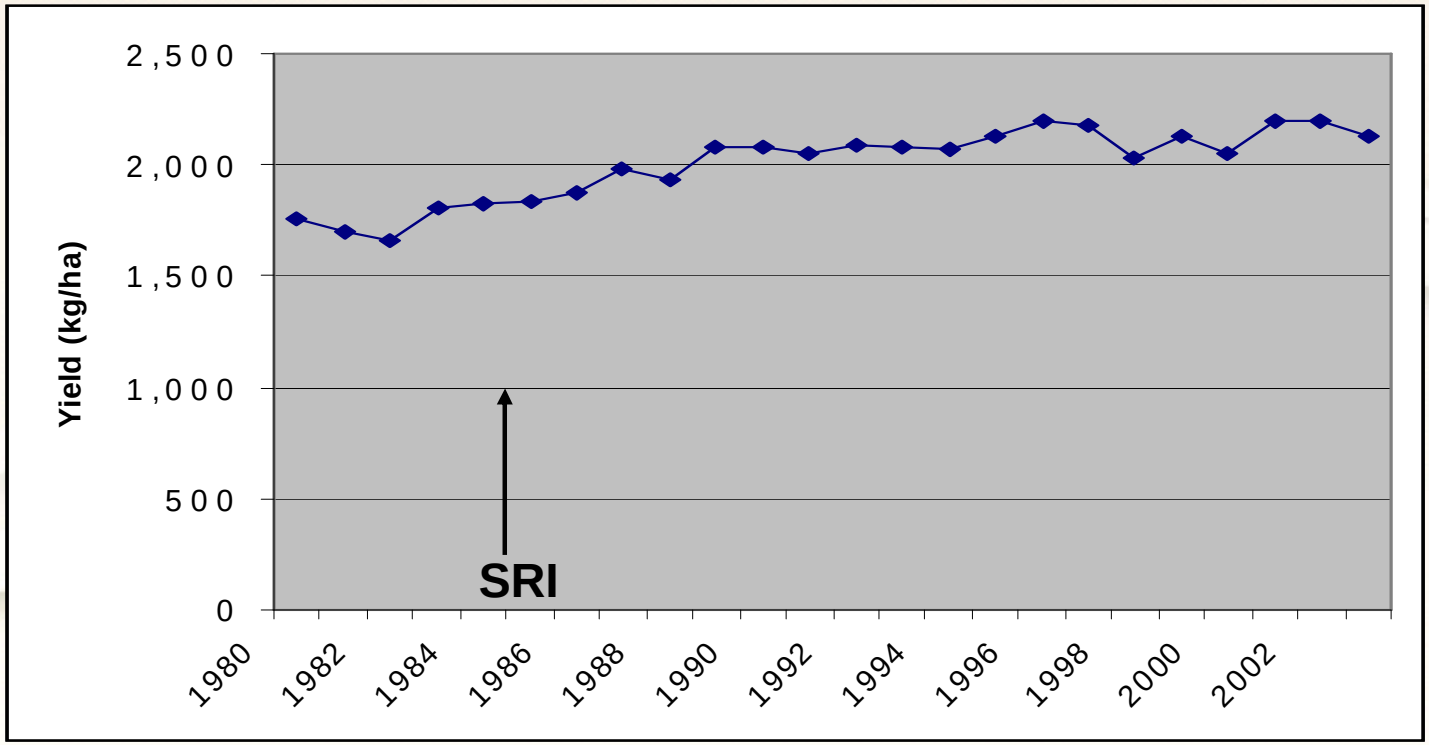


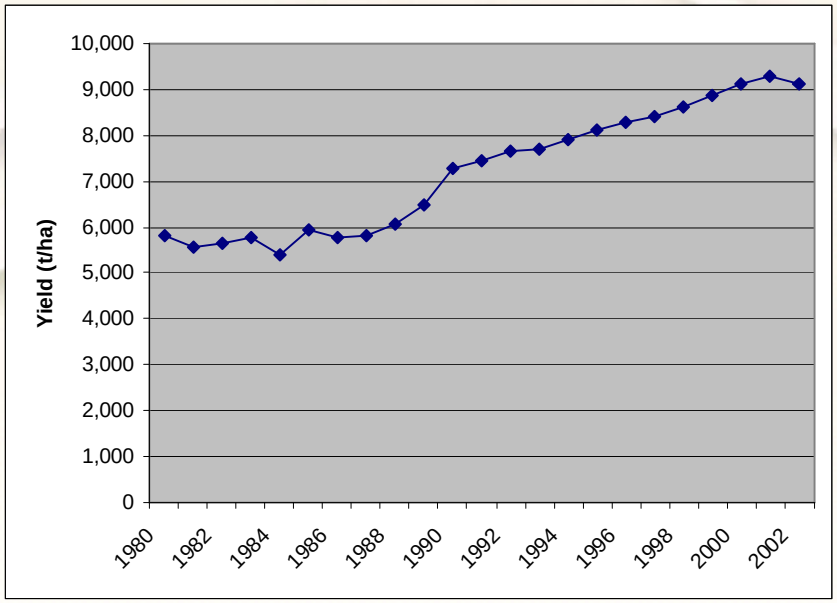
Figure 3. Madagascar rice yield, 1980-2002 (FAOSTAT)

rice is life

THE TECHNOLOGIES FOR MANAGING RICE CROPS AND THE SYSTEMS FOR THEIR DISSEMINATION

Markbouk- 4 System

- Developed and disseminated in Egypt in 1985
- Markbouk-4 = 4 t/fedan or 9 t/ha
- Has 10 crop management areas from variety to harvest



rice is life

THE TECHNOLOGIES FOR MANAGING RICE CROPS AND THE SYSTEMS FOR THEIR DISSEMINATION

P-7 Package

- Developed and tested in Burkina Faso in 1992-93
- P-7 = 7 t/ha for irrigated rice
- Has 7 crop management areas from variety selection to harvest
- Disseminated by Special Programme for Food Security in Burkina Faso and Senegal since 1994
- Increase yield of farmers-co-operators from 4-5 t/ha to 6-7 t/ha

rice is life

THE TECHNOLOGIES FOR MANAGING RICE CROPS AND THE SYSTEMS FOR THEIR DISSEMINATION

WARDA Rice-ICM

- **Developed in 1995 and tested Senegal and Mauritania in 1998-99**
- **Similar to P-7, but**
- **For each crop management area a number of alternative technologies are recommended**

rice is life

Table 2 Yield and net benefit of irrigated rice production in Mauritania and Senegal under traditional farmer practices (TF) and Integrated Crop Management (ICM)

Parameter	System	Unit	Mauri-tania	Senegal
Number of site			4	1
Number of farmers			17	10
Yield	TF	t/ha	3.9	3.8
	ICM	t/ha	5.7	5.5
	ICM - TF	**t/ha**	**1.8**	**1.7**
Net revenue	TF	Euro	284	215
	ICM	Euro	525	399
	ICM - TF	**Euro**	**241**	**184**

rice is life

THE TECHNOLOGIES FOR MANAGING RICE CROPS AND THE SYSTEMS FOR THEIR DISSEMINATION

Australian RiceCheck

- Developed and disseminated in 1996
- Has 7 crop management areas, from field layout to harvest
- For each crop management area, RiceCheck provides:
  - Reason why recommendations should be followed
  - Recommended actions or management practices
  - Expected outputs from correct application of the recommended action
- Principles of IPM and INM were included in RiceCheck for respective crop management areas

rice is life

Box 2. Guidelines for Crop Establishment and Crop Nutrition in the Australian RiceCheck (Lacy *et. al.*, 1993)

CROP ESTABLISHMENT

•*Reason:* Adequate plant population is the first step required to increase yield.

•*Recommended Actions:* Undertake major field layout improvement prior to winter. Start ground preparation early enough to ensure sowing on time. Land surface should be level and uniform enough to suit sowing method. Depending on variety, field layout and soil conditions, sow 125 kg seed/ha when aerial sowing and 135 kg seed/ha when drill sowing.

•***KeyCheck or Expected Outputs:*** ***Achieve 150 to 300 plants/m^2 established through permanent watering at 25 days after seeding.***

CROP NUTRITION:

•*Reason:* Split Nitrogen Strategy - two steps which are important to high yields.

•*Recommended Actions:* Apply sufficient pre-flood nitrogen to achieve optimum growth at panicle initiation, apply phosphorus if a deficiency is indicated by paddock and/or soil test, and top dress nitrogen at panicle initiation based on shoot counts and NIR analysis using the Rice NIR Tissue Test.

•***KeyCheck or Expected Outputs:*** ***At panicle initiation the Amaroo, Bogan, Illabong and Jarrah (rice varieties) should have 700 - 1100 shoots/m^2 and a leaf nitrogen content (NIR) of 1.2 - 2.2% N; while the Pelde, Doongara, Goolarah, YRF9 and YRL34 (rice varieties) should have 500-900 shoots/m^2 and a NIR 1.2 - 2.0%.***

rice is life

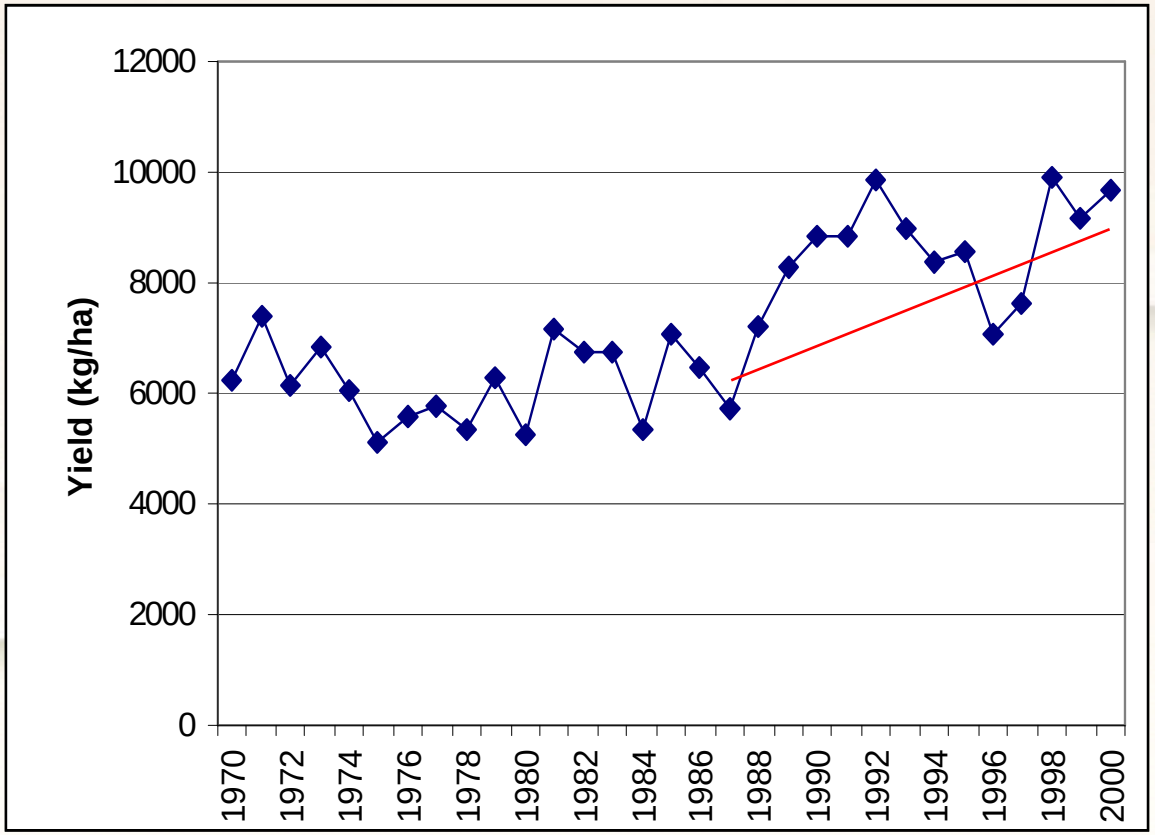


Figure 4 Australian rice yield, 1970 to 2000 (Source: FAOSTAT)

rice is life

FAO PROGRAMME ON DEVELOPMENT AND DISSEMINATION OF RICECHECK

2000 Expert Consultation

- **Observed that the closing of the existing yield gap would require an integrated system that has technologies for all activities in rice production**
- **The integrated system should have a built-in mechanism aiming at enhancing farmer's knowledge in crop management**
- **The Australian RiceCheck system is the most promising for closing the yield gap in rice production in a sustainable manner**
- **Recommended that FAO and its member countries develop and disseminate the RiceCheck system to close the exisiting yield gap.**

rice is life

FAO PROGRAMME ON DEVELOPMENT AND DISSEMINATION OF RICECHECK

Activities during 2001-2003

- **Collaboration with member countries to develop and test modified version of RiceCheck**
- **Indonesia: RiceCheck with 5 crop management areas**
  - **A target of 270 tillers/m^2 at 22 days after transplanting is required for yield of 8 t/ha**
  - **Transplanting 2-3 seedlings/hill at 20cm x 20cm increased N-use efficiency by 17%**
  - **Farmers achieved 5 target values increased yield by 23% and benefit by 165%**
- **Vietnam: Saved 50% of seed used in direct seeding and reduced N-rate by 20%**
- **Brazil and Venezuela: Increased yield by 30%**

rice is life

FAO PROGRAMME ON DEVELOPMENT AND DISSEMINATION OF RICECHECK

Present and Future Activities

- TCP project in Fiji, Philippines, Rwanda and Thailand
- CFC funded project in Brazil and Venezuela through FLAR
- Japan-UN funded projects in Ghana and Sierra Leone, recently approved
- Assist Indonesia, Sudan and Vietnam to formulate TCP as requested

rice is life

CONCLUSIONS

Expert Consultation 2000

- Noted that the situation of global rice production calls for efforts to enhance the productivity and efficiency in rice production
- Observed that there is still a large yield gap and the closing of this gap could substantially increase the productivity of irrigated rice production systems, and that the effective closing of the existing yield gap requires integrated systems approach
- Identified the Australian RiceCheck system as a potential tool for closing yield gap and for increasing productivity and efficiency in irrigated rice production

rice is life

CONCLUSIONS

FAO Programme on RiceCheck

- **Initial results demonstrated that the modified versions of the Australian RiceCheck systems are promising for closing yield gap and increasing the productivity of irrigated rice production in developing countries.**
- **They also indicated that potentially, the RiceCheck system can be updated for achieving the rice production that respects the environment, once environmental indicators (e.g., level of pesticides in water, content of cadmium in rice grain, etc.) are made available by research.**
- **FAO will continue to collaborate with member countries and all stake-holders concerned in the development and dissemination of RiceCheck systems.**

rice is life

THANK YOU

International Year of Rice
2004