# PALAWIJA NEWS

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## Economic Assessment of Terracing in Guizhou Province of China

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### Agricultural situation in Guizhou Province

Guizhou Province is located in the sub-tropical Yunnan-Guizhou Plateau, southwest China. It covers an area of 176,128 square kilometers. This province is one the most under-developed regions in China.

The agricultural gross product in 1995 was 2.27 billion dollars. The farmers' per capita income in 1995 was only 118 US dollars. Guizhou Province is a grain-deficit region of China, with a regional per capita grain production in 1995 of 272 kilograms, only 72% of the national average level.

There are 8 land use types in Guizhou Province (Table 1). Cultivated land, horticulture land, grassland and pasture, and some inland waters (especially lakes and reservoirs) are called farmland.

There are three main topographies, including mountains, hills and hilly areas, and basins. The diversity of topographies provides an important basis for multi-functional development of natural resources.

Karst area constitutes 73% of the total area. This province is one of the typical regions of karst terrain. The main characteristics of karst area are: covered with stones and gravel; with high percentage of sloping land; with fast runoff of rainfall, poor water and soil nutrient preserving capacity; and poor traffic accessibility.

**Table 1 Land utilization types in Guizhou Province.**

| Land Use | Land Area ('000 ha) | Share of Total Territory (%) |
|---|---|---|
| 1. Cultivated land | 4,147 | 23.5 |
| Paddy field | 1,416 | 8.0 |
| Dry field | 2,731 | 15.5 |
| 2. Horticulture land | 73 | 0.4 |
| 3. Forestland | 7,679 | 43.6 |
| 4. Grassland and pasture | 2,365 | 11.7 |
| 5. Residential, industrial and mineral uses | 411 | 2.3 |
| 6. Waters | 192 | 1.1 |
| 7. Traffic use | 81 | 0.5 |
| 8. Non-used land | 2,967 | 16.8 |
| Total territory | 17,615 | 100.0 |

Source: China Statistical Yearbook, China Statistical Publishing House, 1996.

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[*] Commission for Integrated Survey of Natural Resources, Chinese Academy of Sciences, China. This paper is taken from Economic Assessment of Selected Resource Management Techniques in Marginal Upland Agriculture, Monograph No. 36, Bogor: CGPRT Centre.

*Main constraints to sustainable development*

The shortage of arable land is one of the most serious constraints to sustainable agriculture in the province. Other constraints are low quality of the farmland, frequent drought and disasters such as land slides and mud-rock flows, poor capacity for utilizing rainfall and ground water, shortage of agricultural investment, poor education of rural residents, and poor capacity for technological application and adoption by farmers.

*Main advantages for sustainable development*

Some advantages for the sustainable development of agriculture in Guizhou Province are: plentiful reserve farmland; great potential for increasing the agricultural productivity; plentiful cheap rural labour; attention to management of agricultural natural resources by local government including the legislation related to agricultural natural resource management and some basic works completed.

Existing legislation on the management of agricultural resources include the following:

- Measure for Implementing Land Management Law of PRC in Guizhou Province;
- Measure for Implementing Water Law of PRC in Guizhou Province;
- Measure for Implementing Soil and Water Conservation Law of PRC in Guizhou Province;
- Forestland Management Measure of Guizhou Province;
- Implementing Ordinance for Basic Farmland Protection and Conservation of Guizhou Province;
- Environmental Protection Ordinance of Guizhou Province;
- Land Reclamation Measure of Guizhou Province (forthcoming).

Considerable work has been done by local governments to manage agricultural natural resources. The following are the major components:

- Agricultural resource surveys: soil census; agricultural natural resource investigation and agricultural zoning; land resource comprehensive survey; detailed survey of forest resources; grassland resource census; investigation and evaluation of poor productivity land and wasteland;
- The "Population-Grain-Ecology" way of agricultural development has been espoused by the local government, which means controlling population, increasing grain production, and protecting ecology;
- A series of agricultural development projects has been implemented: poverty alleviation programme, agricultural integrated development, green project, watershed management, etc.

*Techniques for agricultural resource management*

There are a lot of techniques for managing agricultural natural resources. All of these aim at taking full use of the existing advantages and avoiding or preventing the existing constraints to agricultural growth. These techniques mainly include the following:

- terracing of sloping farmland and wasteland;
- irrigation in drought-stricken areas;
- drainage in flood-stricken and wetland areas;
- adoption of multiple cropping systems; and
- use of pesticides and chemicals in agricultural production.

**Terracing practices in Guizhou Province**

*Primary objectives of terracing*

Terracing has four main objectives in Guizhou Province. The first is to alleviate the shortage of cultivated land resources. The second is to improve the quality of cultivated land. The third is to manage soil and water erosion. The last objective is to supply more employment opportunities for the rural labour force.

*The options for identifying priority areas for terracing*

There are four options for identifying priority areas for terracing based on:

- land utilization situation: the first priority is presently cultivated land, the second wasteland, and finally land in other use categories including forestland, grassland, etc.
- slope situation: the first priority is land with slope between 15° and 25°, the second is land with slope between 10° and 15°, and finally land with slope over 25°.
- economic development level: first priority is the poverty-stricken areas, and then other areas.
- land area: first priority is the area with potential large-scale contiguous cultivated land after terracing.

# *Message from the Director*

In many cases when I talk with people who are not familiar with the CGPRT Centre, I must explain how the financial resources of the centre are managed.

The financial resources of the Centre fall into the following five categories stipulated in the Centre's statutes: (i) voluntary contributions of the member and associate members of ESCAP; (ii) funds received from other governments; (iii) funds received from international and national institutions; (iv) moneys received for services furnished by the Centre; and (v) other funds received by the Centre.

Since the CGPRT Centre is categorized as an extra-budgetary body of the UN ESCAP, the Centre must seek its financial resources by itself with basic support of the ESCAP Secretariat. The Centre, therefore, does not receive any financial support from the UN budget. The Centre, on the contrary, must pay 13% of the expenditure to the Secretariat as the programme support cost (PSC), although a portion of this is occasionally refunded to the Centre to strengthen its institutional activities.

A few years ago, I introduced, in this column of Vol. 13, No. 1, March 1996, the overall size of the Centre's financial resources in the year for institutional support and programme support at US$425,000 and US$758,000, respectively. For 1999, in comparison, while the estimated expenditure from the institutional support resources remains at a reasonable level to operate the Centre despite a reduction in contribution from a few member countries, the resources for the programme activities are drastically reduced by half. These reductions are apparently due to the current economic crisis in the member countries.

The Centre has always been trying to diversify the sources of funds. But, it is not easy to find "other resources", especially under the current difficult economic condition in the region. In 1998, virtually all financial resources of the Centre were provided under the category (i) above. Although the Centre is not a funding agent to directly solve problems in the individual participating countries, the Centre does like to secure even a limited amount of incentive for the countries to implement collaborative projects together to promote their agricultural development.

The Centre hopes for an early and firm recovery of the regional economies and would like to solicit deep understanding and strong support of the member countries.

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- cultivated land with slope between 15° and 25° and potential large-scale contiguous plots in poverty-stricken areas should be the first priority for terracing.

*Terraced areas*

The terraced area from 1991 to 1995 was relatively stable (Table 2). This was mainly because nearly all of the terraces were planned by local governments. The terracing plans were based on allocated terracing investment.

There are five main types of terracing in Guizhou Province. The first is the transfer of dry sloping field into terraced dry field, constituting the largest portion of the total terraced area. This type of terracing is irrigated or rain-fed, and is mainly used to plant maize. The second is the transfer of dry sloping field into terraced paddy field, which is used to plant rice. Details are given in Table 3.

**Table 2 Terraced areas in Guizhou Province from 1991 to 1996.**

| Year | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Total |
|---|---|---|---|---|---|---|---|
| Area (ha) | 42,811 | 40,230 | 37,776 | 42,355 | 50,416 | 49,071 | 262,659 |

**Table 3 Main types of terracing in Guizhou Province.**

| Terrace Type | Share in Total Terraced Area (%) |
|---|---|
| Transfer dry slope field into terraced dry field | 74 |
| Transfer dry slope field into terraced paddy field | 5 |
| Transfer slope wasteland into terraced dry field | 8 |
| Transfer slope wasteland into terraced paddy field | 1.3 |
| Restore terraces destroyed by floods | 8.7 |
| Other types | 3 |

*Administration of terracing*

There are five levels of administration for terracing in this province. The top level is the Provincial Terracing Headquarters. The second level organization is the Prefecture Terracing Headquarters. The third level organization is the County Terracing Headquarters. Its members come from the County Finance Bureau, Agriculture Bureau, Traffic Bureau, Forestry Bureau, Water Conservancy Bureau and Planning Commission. The fourth level organization is the Township Terracing Headquarters. The fifth level organization is the Village Leading Group.

In Guizhou Province and other areas of China, farmland is mainly owned by village collectives. Private land ownership is forbidden. The land tenure is always obtained by signing contracts with collectives. There is a policy stating that "those who contract, terrace; those who terrace, utilize; those who utilize, benefit".

Agricultural productivity can be increased remarkably after sloping land has been terraced. In order to protect farmers' rights as beneficiaries of terracing, the provincial government has stipulated that agricultural taxes, contract fees and collective administrative costs may not be increased within at least three years of land being terraced.

The government has always emphasized that terraced cultivated land should not be occupied. When requisition is not avoidable, the requested terraced land should be compensated according to the actual total predictable loss of farmers. This kind of loss should include agricultural gross production for five years and terracing costs.

Terracing in Guizhou Province has the following nine steps: selecting terracing sites; field survey of the terracing sites; designing construction blueprint for terracing; training of technicians, skilled masons, bricklayers; organizing terracing construction; physical construction; supervising of construction progress and quality; monitoring and auditing expenditure of terracing funds; and project check and acceptation by special group composed of specialists and officials. Table 4 is a terracing checklist.

## Economic assessment of terracing

*Methodology of assessment*

Data were collected through a structured survey in Pingba County. Steps of data collection are as follows: (i) selection of study site; secondary data collection; (ii) primary data collection through structured survey; (iii) observation on the existing farming practices; and (iv) observation on terracing techniques.

The benefit-cost analysis method was applied for economic assessment of terracing techniques in this project. The total benefits include the following: resource benefits, ecological benefits, economic benefits and social. The costs include material costs and labour costs.

*Reasons for selecting Pingba County as the specific research area*

Pingba County was selected as the specific research area for three reasons. The first reason is that it is representative of Guizhou Province with regard to natural resources and natural conditions. The second reason for selecting Pingba County as the specific research area is that this county has been listed in the SARD Programme, or Sustainable Agriculture and Rural Development in China, organized by the Department of Agricultural Resource Management and Regional Planning under the Ministry of Agriculture. The third reason is the relatively easy traffic accessibility of Pingba County in Guizhou Province. Guizhou's traffic situation is the poorest in China.

*Overview of terracing project area in Pingba County*

The terracing project in Pingba County covers 7 townships, 34 villages, and 5,796 rural households. The total number of rural residents benefiting from the project is 30,319 persons. The duration of the project was five years, i.e. from 1991 to 1995. The total completed terraced area was 807 ha in these five years. There were two types of terraces in Pingba County. One transfers sloping dry field into terraced dry field, making up 98.27% of the total terraced area. The other transfers sloping

dry field into terraced paddy field, making up only 1.73% of the total terraced area (Table 5).

**Table 4 Terracing checklist.**

| Item | Sub-item | Possible Points | Actual Obtained Points |
|---|---|---|---|
| 1. Site selection and blueprint design | 1.1 Site selection | 10 | |
| | 1.2 Blueprint design | 10 | |
| 2. Construction quality | 2.1 Basement quality | 10 | |
| | 2.2 Wall solidity | 12 | |
| | 2.3 Wall thickness | 5 | |
| | 2.4 Wall appearance | 5 | |
| | 2.5 Scale of stones | 2 | |
| | 2.6 Land even or not | 10 | |
| | 2.7 Clear of stones and gravel | 8 | |
| | 2.8 Soil depth | 3 | |
| | 2.9 Project integrity | 5 | |
| 3. Project management and efficiency | 3.1 Project security management | 3 | |
| | 3.2 Project financial management | 7 | |
| | 3.3 Follow-up management | 5 | |
| | 3.4 Project efficiency | 5 | |
| 4. Total Points | | 100 | |

Excellent Project: points over 90; Good Project: 80 - 90 points; OK Project: 70-80 points; Marginal Passable Project: 60 - 70 points; Unacceptable Project: points below 60.

**Table 5 Terraced areas completed in Pingba County from 1991 to 1995.**

| Area | Total | 1991 | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|---|---|
| Areas planned by prefecture terracing headquarters (ha) | 800 | 130 | 130 | 130 | 220 | 190 |
| Terraced areas actually completed (ha) | 807 | 130 | 130 | 137 | 210 | 200 |
| Completion percentage of planned terraced area (%) | 109 | 100 | 100 | 105 | 96 | 105 |

*Cost calculation for terracing*

Terracing has two kinds of costs. The first is material costs: explosives and detonators, drill rods, hammers and rock drills, cubic stones, electricity, machinery, diesel oil, spades, etc. The second is labour costs: project management, blueprint design, survey, masonry, land leveling, clearing stones and gravel in field, terrace wall building, etc.

From the following general analysis, it will be seen that the total cost per hectare was 6,030 RMB Yuan or $ 710, of which the labour cost is 71% (Table 6).

The cost depends upon the slope. In areas with slope over 20°, the total terracing cost per hectare was 12,750 RMB Yuan, twice the average level. In areas with slope below 20°, the total terracing cost per hectare was only 5,700 RMB Yuan or 94.5% of the average level (Table 7).

**Table 6 Total cost per hectare for terracing.**

| Total Cost (¥/ha) | Cash Cost (¥/ha) | Labour Cost (¥/ha) | Working Days (day/ha) | Labour Fee (¥/day) |
|---|---|---|---|---|
| 6,030 | 1,755 | 4,275 | 855 | 5 |

Source: Pingba County Terracing Headquarters.

**Table 7 Total cost per hectare for terracing areas with different slopes.**

| Slope | Total Cost (¥/ha) | Cash Cost (¥/ha) | Labour Cost (¥/ha) | Working Days (day/ha) | Labour Fee (¥/day) |
|---|---|---|---|---|---|
| Over 20º | 12,750 | 3,750 | 9,000 | 1,800 | 5 |
| Below 20º | 5,700 | 1,650 | 4,050 | 810 | 5 |

Source: Pingba County Terracing Headquarters.

*Resource benefit calculation for terracing*

Terracing can expand the former cultivated area by an average rate of 8%. The average plot scale can be expanded from 0.03 ha to 0.9 ha after terracing. The soil layer was thickened from 15-30cm to 40-60cm. The capacity for preserving soil, water and nutrients can be greatly improved, and the fertility can be greatly improved, too.

*Ecological benefit calculation for terracing*

As the survey results show, 807 ha of former soil and water eroded sloping cultivated land was controlled and managed. The soil erosion was decreased by 149 thousand tons of soil. Decease in soil and water erosion resulted in a remarkable increase in agricultural productivity.

The average grain yield could be increased by 20% after terracing due solely to improvement in anti-disaster capability. The destruction from flood and drought disasters was alleviated greatly after terracing.

*Economic benefit calculation for terracing*

The growth of agricultural productivity can be seen in comparison between yields of terraced cultivated land and sloping cultivated land. The average grain growth rate after terracing was 16% (Table 8).

The following tables show the total increased grains solely because of yield increase (Table 9), total increased grain output due to area expansion (Table 10), increased grain output because of improvement in anti-disaster capability (Table 11), total increased grain output due to terracing from 1992 to 2000, and the total added value from terracing (Table 12).

*Social benefit calculation for terracing*

The local grain security improved remarkably after terracing. The total increased grain output reached 2,775 tons over 1992-1996 or 555 tons per year. The per capita grain increased by 96 kilograms.The farmers' income growth due to terracing was 223 thousand dollars, for a per capita income increase of 63 RMB Yuan or 7.5%. The total increased work opportunity in 1992-1996 was 690 thousand working days. This provided additional 45.5 working days per farmer per year for these five years.

**Table 8 Growth rate of grain (maize) yield after terracing.**

| First Year | Second Year | Third Year | Fourth Year and Later |
|---|---|---|---|
| 5% | 11% | 18% | 22% |

**Table 9 Increased grain output only because of yield increase (kg).**

| | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|
| Land Terraced in 1991 | 17,940 | 39,470 | 64,580 | 78,940 | 78,940 | 78,940 | 78,940 | 78,940 | 78,940 |
| Land Terraced in 1992 | | 18,630 | 40,990 | 67,070 | 81,970 | 81,970 | 81,970 | 81,970 | 81,970 |
| Land Terraced in 1993 | | | 19,320 | 42,500 | 69,500 | 84,940 | 84,940 | 84,940 | 84,940 |
| Land Terraced in 1994 | | | | 23,460 | 51,610 | 84,450 | 103,220 | 103,220 | 103,220 |
| Land Terraced in 1995 | | | | | 30,360 | 66,790 | 109,320 | 133,610 | 133,610 |
| Total Increased Grain | 17,940 | 58,100 | 124,890 | 211,970 | 312,430 | 397,090 | 458,390 | 482,680 | 482,680 |

**Table 10 Increased grain output due solely to expansion of cultivated land (kg).**

| | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|
| Land terraced in 1991 | 30,140 | 31,860 | 33,870 | 35,000 | 35,000 | 35,000 | 35,000 | 35,000 | 35,000 |
| Land terraced in 1992 | | 30,140 | 31,860 | 33,870 | 35,000 | 35,000 | 35,000 | 35,000 | 35,000 |
| Land terraced in 1993 | | | 32,500 | 34,310 | 36,470 | 36,900 | 36,900 | 36,900 | 36,900 |
| Land terraced in 1994 | | | | 39,410 | 41,660 | 54,710 | 56,570 | 56,570 | 56,570 |
| Land terraced in 1995 | | | | | 46,370 | 49,020 | 52,110 | 53,880 | 53,880 |
| Total Increased Grain | 34,140 | 62,000 | 98,2300 | 142,590 | 199,140 | 210,630 | 215,580 | 217,350 | 217,350 |

**Table11 Increased grain output only because of improvement in anti-disaster capability (kg).**

| | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|
| Land terraced in 1991 | 97,500 | 97,500 | 97,500 | 97,500 | 97,500 | 97,500 | 97,500 | 97,500 | 97,500 |
| Land terraced in 1992 | | 97,500 | 97,500 | 97,500 | 97,500 | 97,500 | 97,500 | 97,500 | 97,500 |
| Land terraced in 1993 | | | 102,750 | 102,750 | 102,750 | 102,750 | 102,750 | 10,275 | 102,750 |
| Land terraced in 1994 | | | | 157,500 | 157,500 | 157,500 | 157,500 | 157,500 | 157,500 |
| Land terraced in 1995 | | | | | 150,000 | 150,000 | 150,000 | 150,000 | 150,000 |
| Total Increased Grain | 97,500 | 195,000 | 297,750 | 455,250 | 605,250 | 605,250 | 605,250 | 605,250 | 605,250 |

**Table 12 Total increased grain output (kg).**

| | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|
| Land terraced in 1991 | 145,580 | 168,830 | 195,950 | 211,440 | 211,440 | 211,440 | 211,440 | 211,440 | 211,440 |
| Land terraced in 1992 | | 146,270 | 170,350 | 198,440 | 211,470 | 211,470 | 211,470 | 211,470 | 211,470 |
| Land terraced in 1993 | | | 154,570 | 179,560 | 208,720 | 224,590 | 224,590 | 224,590 | 224,590 |
| Land terraced in 1994 | | | | 220,370 | 250,770 | 296,660 | 317,290 | 317,290 | 317,290 |
| Land terraced in 1995 | | | | | 226,730 | 265,810 | 311,430 | 337,490 | 337,490 |
| Total Increased Grain | 145,580 | 315,100 | 520,870 | 909,810 | 1,109,130 | 1,209,970 | 1,276,220 | 1,302,280 | 1,302,280 |
| Total Added Value | 232,928 | 504,160 | 833,392 | 1,295,696 | 1,774,608 | 1,935,952 | 2,041,952 | 2,083,648 | 2,083,648 |

*Calculation of net benefit and identification of the break-even point for terracing*

The total terracing costs and benefits are calculated in dynamic terms. That is to say the interest rate is used in calculating accumulated terracing costs and accumulated terracing benefits. Taking into account China's actual interest rates from 1991 to 1997, an average interest rate of 10% was applied here. The general formulation for calculating accumulated costs or benefits is: $PVn=P_1(1+10\%)^{n-1}+P_2(1+10\%)^{n-2+} \ldots\ldots +P_{n-1}(1+10\%)^1$ , where, n, n-1, n-2, . . . . and 1 are the years n, (n-1), (n-2), . . . . . and 1. $P_1$, $P_2$, $P_{n-1}$ and $PV_n$ are the accumulated value (costs or benefits) in the first year, second year and the year of (n-1) and n, respectively.

From Table 13, an important conclusion can be obtained: terracing did not begin to produce net benefit until 1997 and thereafter, that is to say the break-even point was around 1997.

*Sustainability effects*

Terracing in regions like Guizhou Province is one of the most effective and efficient technologies for sustainable agricultural development. It can effectively and efficiently increase the area of cultivated land on the basis of improving the natural conservation situation without destroying the ecological balance. It can remarkably increase the output of grains and other agricultural products, resulting in great improvement in grain security. It can also greatly increase the farmer's income level, and alleviate and finally eliminate local poverty. It can increase employment opportunities for local farmers.

**Conclusions and recommendations**

*Conclusions*

- Terracing is accepted by most farmers in Pingba County of Guizhou Province.
- Terracing is one of the most effective and efficient ways for simultaneously realizing economic, resource, environmental, ecological and social purposes in Pingba County, and this may be true for Guizhou Province as a whole.
- Terracing is one of the most feasible ways for realizing sustainable agricultural development in Pingba County, and this may be true for Guizhou Province as well.
- There is a severe shortage of terracing investment in both Pingba County and Guizhou Province.
- State investment played, plays and will play a catalytic role in terracing. State investment attracted more investment from local government and enterprises.
- Farmers played, play and will play an indispensable and active role in terracing in Pingba County and the same in Guizhou Province.
- An effective organization system is important insurance for successful terracing.

*Recommendations*

- Specific-purpose terracing investmenet should be increased through common efforts. Local leaders should try to attract foreign investors' attention, including every kind of monetary organization.
- The selection procedure for terracing project areas should be greatly improved downward from provincial government officials to village heads.

**Table 13 Net benefit of terracing.**

| Year | Actual Cost | Accumulated Cost | Actual Benefit | Accumulated Benefit | Net Benefit |
|---|---|---|---|---|---|
| 1991 | 783,900 | 783,900 | | | -783,900 |
| 1992 | 783,900 | 1,646,190 | 232,928 | 232,928 | -1,413,262 |
| 1993 | 826,110 | 2,558,529 | 504,160 | 760,380 | -2,482,491 |
| 1994 | 1,266,300 | 4,166,911 | 833,392 | 1,669,810 | -2,497,101 |
| 1995 | 1,206,000 | 5,789,602 | 1,295,698 | 3,132,488 | -2,657,114 |
| 1996 | | 6,368,562 | 1,774,608 | 5,220,344 | -1,148,218 |
| 1997 | | 7,005,418 | 1,935,952 | 7,678,332 | 672,914 |
| 1998 | | 7,705,960 | 2,041,952 | 10,488,116 | 2,782,156 |
| 1999 | | 8,476,556 | 2,083,648 | 13,620,576 | 5,144,020 |
| 2000 | | 9,324,212 | 2,083,648 | 17,066,282 | 7,742,070 |

- The recommended procedure is: organizing a special provincial technical group including officials and technicians; ordering counties according their actual need for terracing by group; selecting key terracing project areas by county terracing headquarter.
- The terracing standard should be improved
- More attention should be given to fund diversion in terracing. Fund supervising and auditing should be strengthened and improved.

# Economic Assessment of Selected Resource Management Techniques in Marginal Upland Agriculture of Mawlasnai, Meghalaya, N.E. Region of India

*Gour Chandra Munda*[*]

**Introduction**

The issues of sustainability are well enunciated globally and thus there is a general understanding of the challenges. In India, many serious problems of sustainable agriculture are observed in major agroecosystems. Some of these problems are observed in the state of Meghalaya, northeastern region of India. The typical agricultural practice in the region is subsistence farming and it is strongly associated with the increasing population cultivating sloping land leading to soil erosion and land degradation.

This report briefly characterizes the sloping land farming practice in the state of Meghalaya and then discusses some promising solutions of the issues related to sustainable agriculture for the northeastern region.

The objectives of the study are:

- To study the constraints and prospects for sustainable resource management of marginal upland areas with emphasis on economic aspects of resource management, and
- To characterize the transfer/adoption mechanism of resource management techniques and suggest directions for sustainable resource management.

**Sustainability problems**

In India, agriculture continues to be the backbone of economy. About 70% of the total human population is engaged directly or indirectly in this occupation. Over the past three decades, India moved from a food deficit state to a self-sufficient state in foodgrain production although at a low level of availability (514.2 g per capita per day). Presently, about 140 million hectares of the country's total area of 328 million hectares have been brought under cultivation and there is limited scope to bring more area under cultivation to meet all the basic requirements of the people. It is obvious that high yield technologies made an immediate impact on production in many parts of the country and Indian agriculture shall continue to play a crucial role in the country's development. The contribution of agriculture to the gross domestic product of the country during 1990/91 remained at about 30%.

No doubt, it was possible through combined efforts for agricultural production to keep pace with the rising population, but sustainable agriculture production on a long-term basis has become a cause of concern. Intensive agriculture has led to accelerated degradation of the production base (land, water and forest). There is evidence of second generation problems coming up in the form of increased input cost in production, nutrient deficiencies, water pollution and decline in crop yields. Out of a total geographical area of 328 million hectares, 187 million hectares (57%) are suffering from different soil degradation problems. It clearly suggests that unless short and long-term measures are taken to assess our basic resources in order to arrest degradation and restore productivity, it will be difficult to achieve targeted agricultural production.

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**Overview of agriculture in the northeastern region of India**

The northeastern region of India is mostly hilly and mountainous. Agriculture is the main occupation of the people. Crop production activities in this region are carried out under varying slopes (0-100%) and altitudes (50 - 3000 m MSL). The area under cultivation in this region is rather low and concentrated mainly on hill slopes, plateaus, foothills and small valleys. Rainfed crops (rice, maize, millets, potato, ginger, turmeric, etc.) are grown at a subsistence level. Low input use, low use of irrigation potential, low cropping intensity and different land tenure systems are the primary features of existing cropping systems of farming (*jhuming* or *burn or kheti*).

Several issues need immediate attention to attain sustainable agriculture in this region. The major resource management constraints towards achieving sustainability in this area are listed below:

- *Jhuming* (slash and burn method) on steep hill slopes.
- Bun cultivation (raised bed method) along the steep slopes.
- Loss of top soil.
- Deforestation.
- Non-adoption of HYV crops.
- Apathy towards the use of fertilizers and other agrochemicals.
- No storage facilities for ginger.
- Drudgery in farm operations.
- Poor returns from piggeries and other subsidiary sources of income.
- Lack of transport facilities.
- Lack of banking and co-operative facilities.
- Poor economic conditions of farmers.

Most of the farmers in this area face problems arising from inadequacies in the appropriate crop production technology, and lack of much needed services and government policies to overcome the sustainability constraints.

**Important resource management techniques in Mawlasnai**

The cultivated area in the Mawlasnai area (Meghalaya) is concentrated mostly on hill slopes, small valleys and foothills. The important land use and management practices for livelihood by the farmers of Mawlasnai are described below:

*Jhuming* (*slash and burn method*)

*Jhuming* is a primitive form of agriculture. This is a slash and bum method of cultivation practiced on hill slopes. In this method of farming, virgin forest land is cleared by cutting forests and bushes during December-January. The cut materials (trees, shrubs, grasses etc.) are left to dry for some period and then burnt to make the land ready for dibbling of seeds of different crops just before the onset of rain. *Jhum* rice is the main crop grown alone or in mixture with other crops such as finger millet, maize, yam, ginger, vegetables etc. Crops are harvested at maturity beginning from September-October to December-January. Yield levels of the crops are very low. No soil conservation measures are adopted in *jhum* and as a result there is tremendous loss of topsoil reducing the productivity of jhum drastically. In the second year, usually single crop rice is grown. After two to three years, the *jhum* is abandoned and a new site is chosen for *jhuming*.

*Bun cultivation*

Bun method of cultivation is also an age-old resource management practice in uplands prevailing mainly in East and West Khasi hills of Meghalaya. In the bun method of cultivation, raised beds of about 5 metres length, 1 meter width and 30 cm high are made along the hill slopes. Sole cropping as well as mixed cropping is practiced on the bun without using chemical fertilizers or other agro-chemicals. However, application of FYM or burning of organic residues on the bun enriches the soil fertility. Usually, sole cropping of ginger is the first choice in the first year of bun cultivation. However, as per the needs of the family, a combination of crops (ginger, chilli, brinjal, yam, etc.) is also grown in the first year itself. In the second year, the raised beds are leveled and rice or maize is grown as a sole crop. During the third year, sole cropping of maize or mixed cropping is practiced (sweet potato, brinjal, cucumber, etc.). In the fourth year, sole cropping of sweet potato or mixed cropping of ginger, chilli, cucumber, etc. is done. The *bun* is abandoned from the fifth year onward for a period of 3-4 years and farmers shift to a new site for bun cultivation. As in the case of *jhuming,* no soil conservation measures are adopted in *bun* cultivation although there is loss of topsoil right from the first year of its cultivation. As a result, productivity of the bun declines.

*Broom grass cultivation*

Broom grass (*Thysanelaena maxima*) is cultivated as a cash crop on a limited area in Mawlasnai. Root stumps of broom grass are planted on hill slopes or near the homestead. Harvesting of broom is done the third year onward up to 10-12 years, after which the land is kept fallow for few years (3-4 years). The broom excess is sold out of the N.E. region. In broom grass cultivation, also, no soil conservation measures are adopted, but loss of topsoil is expected to be low under broom grass cover.

**Selection of resource management techniques for economic assessment**

Farmers of the northeastern hills region are prone to several constraints resulting in low income level and subsistence agriculture. The basic characteristics of resource management techniques adopted by the farmers here are low input use and labour intensiveness. Usually, low input low risk low yield technology is practiced by the farmers. Considering the level of productivity and vulnerability of hilly upland ecosystems, the following resource management techniques were considered for economic assessment:

- *Jhuming* (slash and burn cultivation)
- Bun cultivation (raised bed cultivation)
- Broom grass cultivation
- Bench terrace cultivation.

**Results of economic analysis of resource management techniques**

Analysis of the economic assessment for different resource management techniques revealed the following facts:

- Benefit/cost analysis showed that broom grass cultivation was the most profitable enterprise compared to other resource management techniques.
- Productivity and economic returns were low in *jhum* but showed marginal profits in the first year only. In the second year onwards *jhuming* was not profitable.
- Sole cropping on bun fetched greater economic returns compared to *jhuming.* Mixed cropping in bun fetched less economic return than sole cropping in bun.
- For bun cultivation, either as sole or mixed cropping, productivity and economic return declined in the successive years.
- Rainfed dry terrace cultivation showed stability in productivity over time. Although the productivity of upland rice and maize varieties tested was not optimum, stable yield was obtained over the years.
- Groundnut, french bean and popcorn were found to be highly productive and profitable crops on dry terraces.

Present value analysis for a period of 15 years revealed that broom grass cultivation fetched highest economic returns and gave a b/c ratio of 1:9.245. Sole cropping in bun ranked next to broom grass cultivation and produced a net economic return of Rs 19,356 and maintained a b/c ratio 1:1.377 over a period of 15 years. *Jhum* cultivation gave a negligible net return of Rs 42 and a b/c ratio of 0.997 over the same period of 15 years. Present value analysis for a period of 15 years under rainfed dry terrace cultivation showed that popcorn was most profitable with a b/c ration of 1:2.185 followed by groundnut (1:2.051). Rice and maize remained marginal in terms on net economic return and b/c ratio.

**Discussion**

Initially the practice of *jhuming* or bun cultivation might have been useful as there was no population pressure and no infrastructure facilities were available at that time. But it is obvious that the practice of *jhuming* or bun cultivation can not sustain productivity in the long run as the *jhuming* or bun cycle is decreasing at faster rate with the increase in population. The practice of *jhuming* or buning has to be either replaced or improved.

Introduction of contour bunding or contour trenching, toposequential cropping, use of HYV crops, use of fertilizers and plant protection measures would be useful to improve or sustain productivity on hill slopes. Contour bunding or contour trenching facilitates continuous cropping which in turn will help in converting the slopes into bench terraces within 8-10 years.

The replacement approach involves terracing on hill slopes. Bench terracing reduces the slope as well as retaining runoff to a great extent minimizing soil loss and nutrient loss. Field crops or a combination of crops can be grown on bench

terraces. The terrace risers, which constitute about 35% to 40% of total area, can be effectively utilized for growing fodder grasses and legumes for maintaining livestock as a subsidiary source of income

*Transfer/adoption mechanisms of resource management techniques*

The agricultural situation in India includes three distinct types of agriculture, viz. commercial, green revolution and complex, diverse, risk-prone agriculture. The complex, diverse and riskprone agriculture is mostly practiced in the northeastern region of India. In this area, the farming system research approach would be more applicable for the improvement and adoption of technology. A farming system research approach provides an important tool to identify the production constraints of farmers. The farming systems are relatively complex and diverse in this environment.

However, there is some definite indication of trends prevailing in this area, which needs a reexamination into the whole problems to develop suitable strategies. The indications are as follows:

- The farmers of this area have become aware of the ill effects of shifting cultivation.
- Dwindling productivity of *jhum* land is a clear indication.
- Specific-location cum need-based alternatives are required instead of a common programme for control of shifting or bun cultivation.
- Allotment of wetland terraces with assured irrigation is the most effective means of attracting shifting cultivators to settled agriculture. This is very much applicable for rice production systems.
- Projects should be allotted on the basis of assured returns provided marketing facilities exist without exploitation by middlemen.

The present scenario of agriculture development in the N.E. region indicates that the farming systems approach would be more useful. Integration of technology for crop production, horticulture and livestock production systems is needed for individual farmers. For this purpose, the institute-village-linkage programme (IVLP) is ideal to assess the existing technology as per the needs of farmers. Efforts are also needed to integrate central as well as the state government agricultural extension programmes for successful adoption of technology by the farmers.

The agro-ecosystem analysis survey is very important before advocating technology for adoption by an individual farmer. Participatory rural appraisal (PRA) tools may be used for this. It will provide information about the resource availability under the farmers' present production practices. It will also reflect the interaction amongst various enterprises of the farm family.

A multi-disciplinary core team of scientists whose disciplines are needed should be constituted. The size of such a team may be limited to 4-5 for better functioning. The core team should draw scientists from crop production, plant protection, economics, soil and water conservation technology and an extension scientist. If some disciplines are not available at the programme implementing centre, efforts need to be made to get the services of such disciplines from the State Agricultural University (Jorhat, Assam), ICAR Research Complex for N.E.H. Region (Barapani, Meghalaya) and the Departments of Agriculture of the N.E. States. This core team should be involved in the institute-village-linkage programme, which will assess and refine the technology before adoption.

Emphasis should be given to development of multiple options for different target groups through the participatory approach. For small farmers emphasis should be given to fine-tuning of technologies for different farming situations. In the case of well-defined production systems, emphasis should be given to on-farm trials and demonstrations. On-farm research will help to increase productivity along with stability and thus risk will be minimized

**Conclusion**

It has been observed that the various farming systems viz. agrobased farming, agri-horti farming or agro-forestry land use systems with animal husbandry as a subsidiary source of income are viable and can sustain productivity. Farming systems must be prepared keeping in view the slope of the watershed, hydrological behaviour of the watershed, soil depth, availability of markets and the needs of the farmers.

**Policy implications**

The northeastern region has special problems in resource management constraining its

sustainability. Short-term as well long-term measures need to be integrated for production advance, as these sustainability factors are interrelated and inter-dependent. Thus, the following policy implications are envisaged:

- Co-ordination among the Indian Council of Agricultural Research, North Eastern Council, North Eastern Hill University, State Agricultural University and the Departments of Agriculture for development activities in the N.E. region. Policy backup should be well coordinated by the line departments.
- Presently, agricultural extension services of the States are inadequate. Competent, skilled and dedicated manpower should be inducted into the extension network to achieve the goal of sustainability.
- NGOs should be involved in the transfer of technology programme.
- The village headman needs to be informed of the usefulness of improved resource management techniques, as he plays an important role in all round agro-economic development of the village.
- Infrastructure facilities for transport, banking/cooperatives and storage of ginger should be developed.
- The procurement policy of the Department of Agriculture for the farmers produce must be defined well in advance.
- Training activities should be strengthened to provide adequate training to the core trainers as well as to the village farmers to impart skills and make them aware of the importance of modern crop production technology.

**Recommendations**

- Immediate priority should be given on the improvement approach to gradually replace *jhuming* or bun methods with appropriate farming system research approaches.
- In the long run, the replacement approach as an alternative to *jhuming* or bun systems should be adopted. Preference should be given to mixed land use (forestry in the higher ridges, horticulture plantation with half-moon terraces in the middle portion, agricultural and horticultural crops at the lower terraces). However, the replacement approach should be adopted on hill slopes with gentle slopes (up to 50%).
- Hills with steep slopes (100%) should be utilized for forestry to produce fuel and timber.
- Foothills should be used for field crops as well as vegetable crops.
- Upland rice is very uneconomical and should be substituted by productive and remunerative crops such as groundnut, soybean and popcorn. Broom grass should also be included in the cropping systems in the upland as it highly remunerative and has soil binding capacity.
- Production of rice under wetland conditions should be intensified by using HYV during the monsoon season with proper drainage and growing of a second crop of *boro* rice during the winter/summer months with assured irrigation.
- On-farm research and demonstration of the improved package of practices for crop production and soil conservation measures by the core team of scientists are essential.
- Training and visit programmes should be arranged for farmers in the transfer of technology programme.

**Future projections**

The ICAR Research Complex for N.E.H. Region, Barapani has developed watershed based resource management techniques through its Farming System Research Project. It has not been tested so far in the villages. It would be useful to demonstrate these watershed based technologies in selected villages to promote sustainable development of agriculture and attain sustainability in agriculture in the N.E. region of India.

# CGPRT Centre News and Activities

## HRD/IS

In November 1998, a regional training course on "Dissemination of Tools for Eco-regional Analysis and Planning for the Development of CGPRT Crops in Asian Monsoon Agriculture (TERAP-1)" was held at the Centre. The course was attended by 14 participants from 12 countries: Bangladesh, India, Indonesia, Lao PDR, Nepal, Pakistan, Papua New Guinea, the Philippines, Sri Lanka, Thailand and Vietnam. The course included topics such as database concepts; design, construction and management of a relational database in Access; GIS applications in agriculture (MapInfo); thematic mapping and geographic overlays; and spreadsheet analysis in agriculture using Excel. The demonstration was continued with the introduction of agricultural policy analysis approaches (e.g. ECOPOL) and tools (MATA). Further, the MATA interface was used to modify economic scenarios for analysis of the resulting impact. Judging from the course evaluation, interest shown by individual participants and results achieved in group activities and exercises and during the training, the impact was substantial.

## TRADELIB

The interim review of the project was conducted for Pakistan in November 1998 and for the Philippines in December 1998.

Some of the first country reports of the project - Pakistan, Malaysia, Republic of Korea, Japan, the Philippines and India - were published as working papers of the Centre in November - December 1998. These reports covered institutional and structural aspects of the effects of trade liberalization on agriculture in each country.

## SUASA-2

Two country reports on the case studies of the project were published in November 1998. Each report included two case studies for each of the participating countries, China and India. Major results of the case studies were also reported at a workshop "Resource Management and Sustainable Agricultural in Marginal Upland Areas" at the Korea Rural Economic Institute. These case studies are summarized in this issue and the previous issue of Palawija News.

## ECOPOL

The ECOPOL project is designed to bring methodological and applied answers to the issue of sustainable income raise in rural areas.

In Vietnam, the project has finished the expert meetings and field surveys on farmers and commodity chains in the province of Ha Tay and has started the same kind of work in the province of Nam Dinh. For the first province, the analysis of the results has already started. Some commodities are used as examples to assess the state of the link between farmers and the market. For Ha Tay province rice and pork production have been chosen while for Nam Dinh province the focus is on high quality rice, pork production and non-agricultural activities.

In Indonesia, due to concerns about the situation in Indonesia and other involvements of the ECOPOL research team, the implementation of the ECOPOL project in Indonesia had been postponed for some time. A new meeting was arranged in November with Dr. Tahlim, the newly appointed Director of CASER to present the project and discuss further implementation. It was agreed that CASER will keep supporting the ECOPOL project. Contacts have also been renewed with the BPTP and BAPPEDA of West Java.

In the Philippines, Ir. Frank Jésus, CIRAD-ECOPOL project co-leader, took part in a training workshop organised by the CGPRT Centre and PCCARD in Los Banos, Philippines, from Sept. 28th to Oct. 3rd, for Philippino researchers. During this workshop, the ECOPOL project was presented and training sessions on the MATA model, on the CADIAC method and on prospective analysis were given.

## Staff Movements

The Centre welcomed several new members and, at the same time, said farewell to several colleagues in 1998.

Dr. Mohammad A. T. Chowdhury and Mr. Gary G. Timoshenko started work for the Human Resources Development and Information Services (HRD/IS) programme at the Centre in January and April, respectively, under the Canadian Universities Services Overseas (CUSO) programme. Also in April, Dr. Robin Bourgeois and Mr. Franck Jesus, both from the Centre for International Cooperation in Agricultural Research for Development (CIRAD, France), joined the Centre on a non-reimbursable loan (NRL) basis to work for the ECOPOL project.

Dr. J.W. Taco Bottema, HRD/IS Programme Leader, left the Centre in April to join the Royal Tropical Institute (KIT) in Amsterdam. The Centre would like to express its sincere gratitude for his devoted services during the long period of thirteen years in Bogor.

Ms. Marion Versapuech from France and Mr. Siemon Hollema from the Netherlands, both Associate Experts, finished their terms in May and July, respectively. Ms. Versapuech is settling into her home in Bali and Mr. Hollema is now with FAO in Rome.

In March, Dr. Kedi Suradisastra left the Centre after completing his two years service as the Research and Development (R&D) Programme Leader. He has resumed his research activity at the Center for Agro-Socio-Economic Research (CASER, Indonesia). In replacing him, Dr. Pantjar Simatupang of CASER took over the post in July.

Mr. Hasrat Madiadipura, Database Assistant, left the Centre in June and Mr. Muhamad Arif rejoined the database section in July as a data entry clerk.

As of 31 December 1998, the Center has following staff:

Professional staff:

Dr. Haruo Inagaki, Director (Japan)
Dr. Pantjar Simatupang, R&D Programme Leader (Indonesia)
Mr. Min-Jae Kim, Programme Officer (SUASA-2) (Republic of Korea)
Dr. Michio Kanai, Project Leader (TradeLib) (Japan)
Dr. Robin Bourgeois, Project Leader (ECOPOL) (France)
Mr. Franck Jesus, Project Leader (ECOPOL) (France)
Dr. Mohammad A. T. Chowdhury, Assistant Training Officer (HRD/IS) (Canada/Bangladesh)
Mr. Gary G. Timoshenko, Database Manager (HRD/IS) (Canada)

Support staff:

Ms. Koniah Suyapura, Administrative and Accounting Assistant
Ms. Fetty Prihastini, Library Assistant
Ms. Sri Angkati Kardinan, Secretary
Ms. Evi Fardiah, Clerk/Typist
Ms. Babay P. Putra, Clerk/Typist
Ms. Rahajeng Pratiwi, Clerk/Typist
Ms. Fransisca A. Wijaya, Clerk/Typist
Mr. Harry Zulfikar, Data Entry Clerk
Mr. Muhamad Arif, Data Entry Clerk
Mr. Zulfarid Irianadi, Driver/Messenger
Mr. Saptadji, Driver/Messenger

## Technical Advisory Committee (TAC) and Governing Board (GB) meeting

The meetings of the Technical Advisory Committee (TAC)* and the Governing Board (GB)** of the CGPRT Centre for the year of 1998 were held at the Centre on 24-26 November and 2-3 December, respectively. The TAC meeting was attended by seven members out of eight and the GB meeting was attended by ten representatives out of the eleven member countries. Ms. Kayoko Mizuta, Deputy Executive Secretary, attended the GB meeting on behalf of the ESCAP Secretariat.

Progress reports of both the Research and Development (R&D) and the Human Resources Development and Information Services (HRD/IS) programmes, together with the management report, were presented at the meetings.

Under the R&D programme, the following projects and plans were discussed:

Completed project:

(i) Economic assessment of selected resource management techniques in marginal upland agriculture (SUASA-2).

On-going projects:
(i) Effects of trade liberalization on agriculture in selected Asian countries with special focus on CGPRT crops (TradeLib).
(ii) Economic and policy analysis for the ecoregional approach in Southeast Asia (ECOPOL)

Proposed projects:
(i) Human resources development to enhance sustainability of upland agriculture in selected Southeast Asian countries (SUASA-3).
(ii) Food security strategies for selected South Pacific island countries (SouthPIC).
(iii) Avenues for agro-industrial development in Southeast Asia (AGRIND).

Future project ideas:
(i) Stabilization of upland agriculture and rural development in El Niño vulnerable countries (ELNINO).
(ii) Development of sustainable potato production in selected Asian countries (SPP).

Under the HRD/IS programme, the following activities and plans were reported, together with those of publication and information services:

Completed activities:
(i) Regional working seminar on agricultural planning in Asia (two weeks in Bogor).
(ii) Hands-on in-country training course on integrated database management (one week each in Sri Lanka and Philippines).

On-going/Proposed activity:
(i) Regional training course on integrated database management at general level (one week) and at advanced level (two weeks) in Bogor.

* Members of the Technical Advisory Committee (as of November 1998)

1. Prof. Jean-Marc Boussard
   National Institute of Agricultural Research (France)
2. Dr. Euan Fleming
   University of New England (Australia)
3. Dr. Raghunath D. Ghodake
   National Agricultural Research Institute (Papua New Guinea)
4. Prof. Masao Kikuchi
   Chiba University (Japan)
5. Prof. Dr. Arie Kuyvenhoven
   Wageningen Agricultural University (The Netherlands)
6. Dr. Dong-Phil Lee
   Korea Rural Economic Institute (Republic of Korea)
7. Dr. Soemarno
   Central Research Institute for Food Crops (Indonesia)
8. Dr. Boonjit Titapiwatanakun
   Kasetsart University (Thailand)

** Members of the Governing Board (1997-1999)

1. Bangladesh
2. France
3. India
4. Indonesia
5. Japan
6. Myanmar
7. Papua New Guinea
8. Philippines
9. Republic of Korea
10. Sri Lanka
11. Thailand

# Announcements

## 12th International Course on Seed Production and Seed Technology

**International Agricultural Centre**
**Wageningen/the Netherlands April 11 - July 15, 1999**

The programme comprises lectures, practicals, role plays, discussions, demonstrations and excursions. In addition to traditional seed technology topics the course will also deal with seed sector related managerial, policy and planning aspects, such as:

- Target oriented project planning/logical frameworks;
- Project economy;
- Seed legislation;

- Policy issues at national level.

Furthermore, participants will attend a 10-day seminar on Seed Quality Assurance and ISO-9000 certification in the seed sector.

The programme centres around the following main topics:

- National seed supply: case study of a national seed sector, seed legislation, informal seed sector;
- Seed quality: seed laboratory and field activities, seed physiology, pre and post control, seed certification, seed quality assurance;
- Varietal concepts: introduction to plant breeding, varietal maintenance, variety research and identification of varieties, farmers' choice and consumers' preferences;
- Production agronomy: inspection and roguing seed production fields, contract growers production planning, ecosystems versus seed production;
- Seed processing: seed cleaning practices, visit to seed processing plant;
- Post harvest operations: seed treatment, storage, seed pelleting and coating, packaging and marketing;
- Seed health: seed production epidemiology and practicals on seed health;
- Other subjects: statistical design, extension, gender issues, project economy.

## 28th International Course on Integrated Pest Management: Strategies to Control Diseases and Insect Pests

**International Agriculture Centre**
**Wageningen/the Netherlands March 21 - July 3, 1999**

The course intends to broaden the participants' view on plant protection and its role in plant production, and to strengthen the knowledge of and the skills in plant protection methods with emphasis on IPM, in order to allow the participants to use IPM, its concepts and related techniques, in their own work situation.

The curriculum of the course is organized in discipline oriented modules, particularly bacteriology, entomology, mycology, nematology, virology, weed science, and interdisciplinary and general modules. The general modules are: (i) introduction, (ii) presentation techniques, while the interdisciplinary modules are: (i) development of IPM, (ii) pesticide management, (iii) IPM research, extension and implementation and (iv) project proposal.

## 28th International Potato Course: Production, Storage and Seed Technology

**International Agriculture Centre**
**Wageningen/the Netherlands April 11 - July 16, 1999**

The objective of the course is to provide persons working in developing countries who are engaged in aspects of potato production, with further knowledge and understanding of and skills in various aspects of their work. These aspects include: physiology, growth and production; storage, handling and utilization; diseases and pests; seed technology, seed production and seed supply; breeding and varieties.

## 48th ICRE Programme of Extension Courses

I Rural Extension for Natural Resources Management
II Research-Extension-Farmer Linkages
III Management of Extension Organizations

**International Agricultural Centre (IAC)**
**Wageningen/the Netherlands June 13 - July 24, 1999**

The ICRE training programme aims at strengthening the capability and performance of professional staff and their organizations involved in rural development and natural resources management in developing countries and economies in transition.

## 29th International Course on Applied Plant Breeding

**International Agriculture Centre**
**Wageningen/the Netherlands March 14 - June 26, 1999**

The course is an in-service training course inteded for university trained specialists in plant breeding, mainly from developing countries, who have not recently had the opportunity to acquaint themselves with modern plant breeding techniques. Its aim is to upgrade the participants' knowledge of and to give information on new developments in applied plant breeding through lectures and practical training.

## 29th International Course on Vegetable Production

**International Agricultural Centre**
**Wageningen/the Netherlands August 8 - November 13, 1999**

The course intends to extend and deepen participants' knowledge of vegetable growing and to acquaint them with various production and post harvest aspects.

The course aims at providing participants with information, tools and insights on how to make farmers achieve their vegetable production potential and to acquaint them with post harvest aspects such as handling and marketing.

For further information, contact:
International Agricultural Centre (IAC)
P.O. Box 88
6700 AB Wageningen, the Netherlands
Lawickse Allee 11
Telephone: +31-317-490111
Fax: +31-317-418552
E-mail: iac@iac.agro.nl
Telegrams: INTAS
Telex: 45888-INTAS NL
Internet: http//www.iac-agro.nl

## The Third International Soybean Processing and Utilization Conference (ISPUC-III)

**Tsukuba, Ibraki, Japan**
**October 15-20, 2000**

The objective of ISPUC is to stimulate an exchange of scientific and technological information on all aspects of research and development of soybean processing and utilization. The ISPUC-III follows the previous two conferences: the first one was held in the People's Republic of China in 1990 and the second in Thailand in 1996.

The ISPUC-III to be held in Japan envisages, among other things, to share Japanese experiences and information with the worldwide communities associated with soybean processing and utilization, since Japan has made significant developments in this specific field.

For further information, contact:
Secretariat for ISPUC-III
c/o Congress Corporation
7th Akiyama Bldg., 5-3 Kojimachi, Chiyoda-ku
Tokyo 102-0083, Japan
Telephone: 03-3263-5896
Fax: 03-3263-4032
E-mail: ispuc3@congre.co.jp
URL: http//www.nfri.affrc.go.jp/gyoji/soybean.html

## International Course on Management of Agricultural Information Services

**Wageningen/ Amsterdam, the Netherlands**
**September 13 - 24, 1999**

The course offers a comprehensive framework for the design, implementation and evaluation of an information service, based on analysis of the information landscape, developments in information technology and on the needs of clients. It will include the formulation of an information strategy and address aspects of financial and human resources management. Attention will be also be paid to pricing of information products.

For more information, contact:
Mr. F.A. Neuman
International Agricultural Centre
P.O. Box 88 6700 AB
Wageningen, the Netherlands
Telephone: 31 (0) 317-490234
E-mail: f.a.neuman@iac.agro.nl

**CGPRT Centre**

The Regional Co-ordination Centre for Research and Development of Coarse Grains, Pulses, Roots and Tuber Crops in the Humid Tropics of Asia and the Pacific (CGPRT Centre) was established in 1981 as a subsidiary body of UN/ESCAP.

**Objectives**

In co-operation with ESCAP member countries, the Centre will initiate and promote research, training and dissemination of information on socio-economic and related aspects of CGPRT crops in Asia and the Pacific. In its activities, the Centre aims to serve the needs of institutions concerned with planning, research, extension and development in relation to CGPRT crop production, marketing and use.

**Programmes**

1. Research, which entails the preparation and implementation of studies covering production, utilization and trade of CGPRT crops in the countries of Asia and the South Pacific.
2. Training of national research and extension workers,
3. Information and documentation which encompasses the collection, processing and dissemination of relevant information for use by researchers, policy makers, and extension workers.

***Palawija News***

Contributors are invited to submit concise summaries of significant social research related to CGPRT crops for publication. Figures (graphs or tables) may accompany the article. All articles are subject to editing to meet space limitations.

Please send all queries relating to articles in *Palawija News* to Publications Section, CGPRT Centre, Jalan Merdeka 145, Bogor 16111, Indonesia.

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