RICE DOUBLE CROPPING IN AFRICA: THE CASE OF THE MALAGASY REPUBLIC, CAMEROON AND SENEGAL

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ABSTRACT

In collaboration with National Centers, IRAT has conducted several rice double cropping experiments in some African countries since the early sixties. Assuming excellent cultivation conditions, including water availability, proper fertilization and weeding management, the results obtained are as follows:

- Rice double cropping system ensures more than 10 t/ha/year;
- Two different varieties are usually necessary, due to the differences in the weather conditions between the dry and wet season;
- The most important constraints are water availability, mostly during the dry season, weeds and either diseases or pests, depending on the locations;
- Double cropping is technically feasible and economically sound for the farmers;
- Research is still necessary for the development of new varieties, and the use of low cost inputs (mostly nitrogen which is indispensable to ensure high yields), based on the experimental results covering a long period of time (except for Cameroon).

Madagascar

Traditionally, double cropping is seldom practiced at Madagascar.

Even when a farmer is cultivating two crops a year, as for instance in the eastern and northwestern coastal areas, he is not using the same fields, mostly due to factors including water requirements and availability. In general, land management is not good enough to allow for double cropping.

However, the Agronomy Research Institute at Madagascar which belongs to the Tropical Agronomy Research Institute, France, conducted several rice double and continuous cropping experiments during the sixties and the seventies with two objectives:

1) To evaluate the highest yield potential that can be attained with the best management and cultivation practices in areas where continuous cropping is possible, depending on the weather conditions.
2) As a demonstration for the farmers to show them that, with few and appropriate land facilities, (mostly irrigation and drainage management) it is technically and economically feasible to implement the rice double cropping system.

To illustrate these objectives, three examples are presented:

1 Continuous cropping in the North (Diego-Suarez Province) from January 1972 to June 1974. An experiment with early varieties was conducted on a very good old volcanic soil, in a location where farmers are traditionally obtaining about 1 t/ha with direct sowing and low management (no fertilizers, no water control).

The results are given in Table 1.

Such an experiment shows the following:

1) A total mean yield per year ranging from 22.5 to 25.4 tons is technically possible in that area, using any one of the three best varieties.

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Table 1 Six continuous croppings at Madagascar, northern area. Duration in days covers transplanting-harvesting period

Variety name	Origin	Total yield t/ha (490 days)	Yield (kg/day/ha)	Mean yield per crop t/ha
Chinsei - Asahi	Japan	34.042	69.5	5.67
Benloch/Ohachi	Spain	31.604	64.5	5.27
Caloro	USA	30.291	61.8	5.05
C.D. 7786	USA	28.670	58.5	4.78
Paltal	Korea	27.280	55.7	4.55

2) Excellent management, including optimum water control and drainage, is, of course, necessary.
3) The selection of a good variety - these 5 varieties result from selections within 310 cultivars previously screened - including the most resistant to diseases and pests to reduce problems and treatment costs, is a very important practice.
4) Such a continuous cropping system is economically feasible with an excellent net return to the farmers, assuming that the cost of production is minimized by reducing as much as possible the cost of pesticides.

2 Continuous cropping in the eastern coastal area (Tamatave) from March 1967 to March 1968.

An experiment with three varieties was conducted on a medium alluvial soil, in a location where farmers are traditionally obtaining about 2 t/ha per year with direct sowing and low management (no fertilizers, poor water control).

The results are presented in Table 2.

Table 2 Three continuous croppings at Madagascar, eastern area. Duration in days ((1): 322 days instead of 335 for Chianan 8) between transplanting and harvesting

Variety name	Origin	Total yield t/ha (335 days)	Yield (kg/day/ha)	Mean yield per crop t/ha
Cianan 8 Taichung 150 (first crop) +	Taiwan	20.438	61.0	6.81
Taiwan 3 (second and third crop)	Taiwan	16.947 (1)	52.6 (1)	5.65

The conclusions are exactly the same as for the previous experiment. However, total yields are slightly lower ranging from 19.1 to 22.3 tons per year, due to the soil conditions and higher insect - stemborers - pressure.

3 Evaluation of double cropping systems

Many double cropping experiments have been conducted during the sixties and early

seventies in several areas: north-western, eastern and southwestern coastal areas, under controlled conditions in several experimental farms.

Two examples only are given:

A Eastern coastal area:

A summary is presented in Table 3.

Table 3 Double cropping using 3 varieties (East coast)

Variety name	Origin	Period	Yield (t/ha)	Duration in days (t-h)
A Chianan 8	Taiwan	1967-1974	4.77	120
A Java	Local check	1965-1974	3.56	140
B Chianan 8	Taiwan	1964-1969	5.24	140
B Manasamanana	Local check	1964-1968	3.28	140

T-H: Transplanting-Harvesting duration
A: Wet/hot season B: Dry/cold season

The experiment shows the following:

1) Total yield per year with the improved variety is 10 t/ha, instead of 7 t/ha with local checks.
2) The grain production per day is about 40 kg.
3) The yields are higher during the dry/cold season for the improved varieties, probably due to higher solar radiation.
4) The seed to seed duration is longer during the dry/cold season for the improved varieties.

To obtain such results the best possible management is required: water control, fertilization (from 60 to 80 N units for each crop) and weed control. No pest and disease treatments were applied.

B South-western coastal area:

A summary is presented in Table 4.

Table 4 Double cropping using 4 varieties (South West)

Variety name	Origin	Period	Yield (t/h)
A Makalioka 34	Local	1963-1968	4.179
A Tsipalamena	Local check	1963-1968	3.789
B IS 20	Local	1963-1966	5.871
B Tsipalapatsy	Local check	1963-1966	3.723

A: Wet season B: Dry season
Rem: Same conclusions and same management as for the eastern coastal area.

4 Conclusion

Double cropping and/or continuous rice cropping is feasible at Madagascar when the

elevation is lower than about 300 meters. At higher elevations, double cropping is difficult to implement, because the temperature decreases with the increase in altitude.

Total yield per year is about 10 tons with two crops and about 20 tons with continuous cropping.

Continuous cropping requires very early entries to be fully efficient. If the choice of the improved varieties to be used is important for the success of double cropping, more important is the management: water control, including irrigation and drainage, fertilization with high levels of N and P inputs, weed control are necessary. The latter factors very much restrict the adoption of such a cropping system by the farmers, because, most frequently, water control, is not sufficient enough.

Even with the best management, the problems associated with pests and diseases have to be solved: their incidence is growing rapidly with the number of crops, and sooner or later, chemical control will become necessary. However, the results obtained during the 10-20 year period show clearly that very high yields can be obtained. It is certain that better results could be achieved nowadays by using better varieties and techniques than those used at that time.

Cameroon

Rice cultivation is traditional in the far-northern part of Cameroon (Maroua, Yagoua). During the fifties and early sixties, the average yield for the single crop per year was about 1.3 t/ha for the 3,000 hectares cultivated. During the late sixties, after water control with pumping was practiced in 1966 and after land levelling, the average yield reached 2 t/ha.

In the early seventies, double cropping was successfully practiced on an experimental scale because water was fully controlled throughout the year with the newly created irrigation management. In 1984, a survey showed that the farmers are not only very much interested in double cropping which gives them a higher net income, but are also requesting more research and experiments on rice triple cropping.

In this area, double cropping is applicable due to seven important factors:

1) A long dry season that facilitates the ripening and harvesting of the two crops.
2) Full water control throughout the year and low to moderate water cost.
3) Excellent and efficient drainage.
4) Favorable temperatures during the dry season.
5) Varieties which are adapted to double cropping, are cold-tolerant and not photoperiod-sensitive.
6) No disease pressure.
7) Rice activities compatible with other crops.

Presently, the results can be summarized as follows:

1 Land levelling and water control

Good land levelling, but above all full water control, both for irrigation and drainage, are the two necessary conditions for double cropping. Pumping from the river Logone and Maga artificial lake ensures continuous water availability and easy water management adapted to the crop requirements.

2 Very strict calendar of farm activities

These activities are outlined in Table 5.

Thus the total number of days required is, on the average:

102 days during the dry season

109 days during the rainy season

154 days for drying, threshing, fertilizer application and land preparation (plowing, harrowing and levelling).

Table 5 Rice double cropping activities in North Cameroon

Month	Climatic environment	Activities
July	Rain	Final plowing, nurseries, transplanting
August	Rain	Fertilization, weeding
September	Rain	Weeding
October	Last rain	Weeding and harvest
November	Early cold	Threshing, marketing, plowing
December	Cold	Nurseries
January	Cold	Transplanting
February	Cold	Weeding, fertilization
March	Hot	〃
April	Hot	〃
May	First rain	Harvesting
June	First rain	Threshing, marketing, plowing

3 Adapted and high-yielding varieties:

After having used, during the fifties and sixties, several varieties such as local Maroua, M32, M23, Neang Veng (from Chad), Dissi, D52-37 and 63-83, two varieties were widely used during the seventies: Taichung 178 and IR24, but their duration was too long during the cold season.

Therefore during the last part of the seventies, experiments showed that IR46, the only variety presently used over very large areas, can produce every year from 5 to 6 t/ha per crop, with a mean yearly production of 10 t/ha. The seed to seed duration is 129 days during the rainy season and 142 days during the cold season.

This duration is somehow too long and very recent (1983-1985) experiments demonstrated the advantages of two other varieties, namely: BKN LR 75001 - B3 - CNT - B4 - RST 47 - 1 and IR 4219 - 22 - 1 - 1 - 2. Their yields are the same as those of IR46, their duration is two week shorter, but their grain quality is not as good as that of IR46.

As a conclusion rice double cropping in northern Cameroon is applicable and also essential to increase farmers' income due to the high and growing population density (70 km^2). Intensive cultivation practices, including fertilization and proper weeding are necessary for obtaining maximum yields, i.e. 10 t/ha as an average per year. The National Authority in charge of the area, the SEMRY, has clearly demonstrated for many years that rice double cropping can be adopted by local farmers in Africa, provided that all the production factors, including mainly full water control, are technically and economically effectively controlled.

Senegal

In northern Senegal, along the Senegal river, rice cultivation is traditional. In this area, rainfall is very low: 300 mm/year as an average, and the summer temperatures are very high when winters are cold.

The first double cropping experiments were carried out in 1965. During the early seventies, a survey showed very clearly that double cropping was successful in that region:

During the dry season, using the best techniques, the yields were as follows:

Taichung native 1:	6.33 t/ha
Taiwan 3:	6.25

During the wet season, the yields were lower:

D 52/37	3.53 t/ha
D 9-9	3.19

H 14-11 B	3.69

The best combinations for double cropping are:

D 52/37 + Taichung native 1:	13.20 t/ha/year
D 9/9 + Taichung native 1:	14.13
D 9/9 + Taiwan 3:	13.11

(as a specific result for one given year in a given area).

More recently, the results are showing the advantages of the following varieties:

Cold wet season	Dry hot season
1 Kong Pao	IR 28 IR 30
Taichung native 1	IR 2071 - 625
IR 8	IR 26
H 18 - 101 B	Jaya
IR 20	NTU 770

The highest yields were obtained with IR 2071 (10 t/ha) and Jaya (12 t/ha). Presently the results obtained can be summarized as follows:

1) The best varieties are yielding between 12 and 15 t/ha/year in experiments, on the average.
2) The importance of nitrogen fertilization (both nitrogen fertilizer and manure). Even with an application of 200 kg/N/ha per year, any rice crop is advantageous to the farmers, and the net return is very high. However the farmers apply generally only 120 kg/N/ha.
3) No response or very low response with phosphorus and potassium application.
4) The key to the success is weed control. Several herbicides are highly recommended to the farmers and are very efficient: Propanil, Basagran, Ronstar, Stam F34 are the best ones. But the problem to solve is the control of wild rices.
5) Insect attacks are more dangerous than diseases and the losses can be estimated at 2 to 3 t/ha. The use of insecticides which is always efficient and economical is practiced by the farmers: FUDARAN is widely used, but AZODRIN and DICOFOL are promising.
6) Cultural practices include:
   Sowing: from June to September, depending on water availability, 120 kg/seeds per hectare
   Plowing: deep plowing every 3 years is recommneded.

As a conclusion, although double cropping is economically sound and technically applicable in northern Senegal along the Senegal river, that practice is not widely adopted by the farmers for two reasons:

1 Water supply is sometimes insufficient;
2 Other crops, and mostly vegetables, have so far yielded higher returns.

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Discussion

Soetjipto Partohardjono (Indonesia): In considering the potential and limitations of continuous rice cropping in Madagascar, what is your opinion on the consequences of this practice in the development of diseases and pests as well as in soil fertility in the long run? What is your experience in Madagascar?

Answer: Experimental results show clearly a decrease in yields associated with continuous cropping when proper cultivation practices are not applied. It is likely that in future problems and constraints such as the incidence of pests and diseases as well as the decline of soil fertility will become more serious. Continuous cropping requires a higher use of inputs such as insecticides which in turn results in a higher production cost. Further research is needed to gain a better understanding of the mechanisms involved in the biological environment of continuous rice cropping.

Abu Bakar Taib (Malaysia): Given the problems of water shortage and the large amount of water required for rice-growing what advice have FAO and other related agencies given to switch to crops which do not consume as much water as rice does?

Answer: Several considerations are to be taken into account: water availability as well as rice price as compared with the income from other crops. In Senegal for example farmers are able to derive a higher income with less water use and they frequently cultivate tomatoes as a second crop. The cultivation of grain legumes, potatoes or short duration forage crops for cattle feeding during the dry season could also be suggested, as in the case of Madagascar. It is evident that double cropping of rice is not always a good solution in taking account of the scarcity of water resources in the semi-arid tropics in particular.

Perez, A.T. (ADB): You have given an excellent report on the problems and potential of rice production in three countries of Africa. I have observed the successful joint venture in northern Cameroon between the government and private companies you described. Please comment on the feasibility of producing rice through the effort of farmers' organizations or on large farms through joint ventures between the government and the private sector.

Answer: The solutions to this problem will vary depending on the national policies, amount of resources available and constraints. As the main constraint is represented by water availability and since the construction of irrigation and drainage facilities is very expensive, it may be advantageous for certain governments to undertake irrigation projects jointly with the private sector, as in the example presented earlier. However in other countries, like in Madagascar, such a system is not available and only farmers can operate such schemes, which would be difficult due to the lack of funds.

Ali Hassan Haji (Tanzania): When harvesting takes place in the rainy season, as in the case of Cameroon, how is it possible to avoid the sprouting of grains?

Answer: This is a difficult problem to solve. The ideal solution is to dry paddy with dryers immediately after harvest. An other possibility is to modify the cropping pattern. However it may be difficult to avoid sterility caused by low temperature, in such a case.