Farmers' Adaptations to Production Constraints and its Implications for Agricultural Research: The Case of Rice Production Systems in the Dominican Republic

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Self-sufficiency in rice production is one of the major objectives of government agricultural policy in the Dominican Republic. Therefore, heavy emphasis is put on double cropping, while other production systems, such as ratooning, are discouraged. In this paper traditional production systems employed by farmers in the Dominican Republic are described. It is argued, that in many cases these systems are well adapted to, or are a result of constraints in production conditions. As such, they are rational solutions to the many problems of an infrastructural nature, particularly faced by small farmers. It is suggested that under specific conditions some of the production systems may well be more cost effective, both at a micro and macro level, than double cropping. Therefore, it is recommended to incorporate these systems into the national rice research activities.

In this paper, we will describe and analyze small farmers' rice production systems in the Dominican Republic. We will look at these systems as answers to constraints in small farmers' production conditions. Thus, we hope to indicate that production systems used by small farmers, although perhaps not very high yielding in absolute terms, may be fairly effective in adding to total production under conditions in which high yielding systems such as double cropping are difficult to realize.

Data on farmers' production systems, conditions and decision making were gathered within the framework of the Adaptive Agricultural Research project. This project, aimed at establishing how and what sociologists can contribute to agricultural research, has been a joint effort of the Dominican Ministry of Agriculture and Agricultural University of Wageningen, the Netherlands. Sociologists and agronomists have been working together since 1981 in agronomical problem identification among small scale cassava and rice farmers through the use of in-depth case study interviews, a survey and adaptive trial research. (More information on methodology and results of the AAR project can be obtained at CENDA, Apdo. 700, Santiago, Dominican Republic; or after January 1985, with Dr. Louk de la Rive Box, Dept. of Rural Sociology of the Tropics and Subtropics, Agricultural University, Salverda plein 10, Wageningen, The Netherlands.) Survey data from the same project are used for quantitative information on the occurrence of different rice production systems in the regions around Nagua, in the northeastern part of the Dominican Republic, and Mao, in the northwest.

In the following, we will first present some general information on rice cultivation and research in the Dominican Republic. Subsequently, we will describe the agronomic and economic aspects of the two most important production systems in the Dominican Republic: double cropping and ratooning.

Then, the "riso" and the "mateo," two other, less frequently occurring production systems, will be described in terms of the conditions in which they are used by farmers. We will conclude by trying to indicate what implications our analysis might have for agricultural research efforts in the Dominican Republic.

Rice Cultivation and Research in the Dominican Republic

Rice is the most important staple in the Dominican Republic. In area sown, production value, labour and capital invested it is second only to sugarcane (SEA 1981, page 5). According to Cordero (1978), some 98% of the physical rice is officially classified as irrigated. However, about one-fourth of this land exists with such a poor irrigation infrastructure that rice grown on it would be better defined as upland rice grown under favourable conditions.

In 1983, 99,733 hectars were sown with rice (Cuevas Pérez, 1983). On a physical rice area of 90,400 ha, this implies that the average number of cropping cycles for that year was only about 1.10. This figure indicates that double cropping is more an exception than the rule. This is surprising, considering the fact that the larger part of the rice area is dedicated exclusively to the cultivation of this crop.

In certain regions in the country, ratooning is practiced instead of sowing a second crop. In 1982, about 12,000 ha were ratooned, almost 20% of the 62,000 ha sown during the first cropping cycle. If one would consider a ratoon as a second crop, the average number of cropping cycles in 1982 would amount to 1.23.

Since the 1960's, rice research has been executed at the Centro de Investigaciones Arroceras (CEDIA), located near the town of Bonao in the fertile lands of the central region of the Dominican Republic. Rice breeding has been the most important and successful component: at present, major areas are sown with locally released varieties such as "Juma 57," "Juma 58," and "Juma 60." Apart from these varieties, a package of recommendations was developed, based on the sowing of two crops per year, and including an ample use of modern inputs such as fertilizers, preemergent herbicides, fungicides and insecticides.

Double Cropping

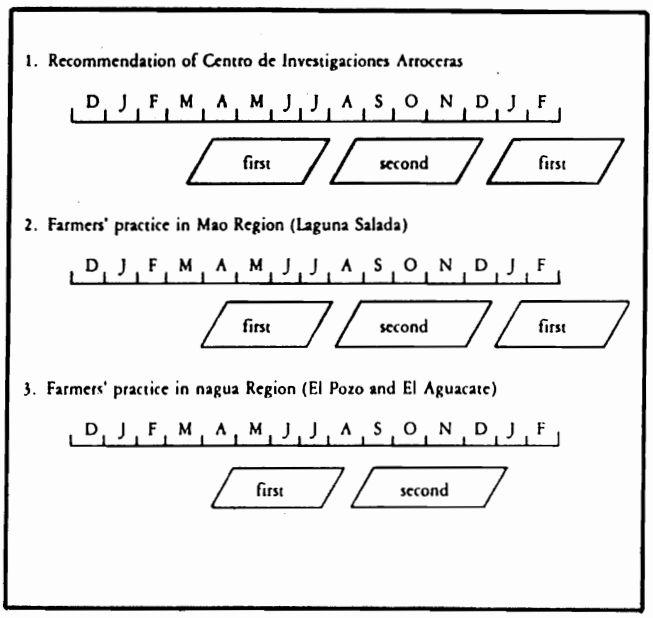
The production system recommended by the rice research institute CEDIA is double cropping. Also, the rice researchers advocate establishing these crops at specific dates: the first crop in December and January; the second in June or July.

The purpose of this recommendation is to avoid having to sow or transplant the second crop "out of season," after mid-August. Crops sown after this date, in the September-November period, have been shown to result in significant yield reductions due to low temperatures and lack of solar radiation. Also, major damage is caused by the winds of January and February, which affect the rice plants in the flowering stages, causing a high percentage of unfilled spikelets ("vaneo," in terms of the farmers).

Considering these recommendations, what do the farmers practice? The planting dates most commonly used in two major rice production areas, the Mao and Nagua regions, are depicted in Diagram 1. As can be seen, the practice of Mao farmers coincides rather well with CEDIA's recommendations. On the other hand, Nagua farmers generally establish their first crop much later than recommended, in March-April instead of December-January. The reason is that problems with the supply of irrigation water expose crops sown in December and January to the drought spells of the February-March period, at that phase of plant development when water is most needed.

Therefore, farmers prefer to sow when the rains start, in April. However, this means that the large majority of farmers will not be able to establish the second crop before September, which leads to "sowing out of season," in terms of the rice research institute. Farmers in the Nagua region, although not conceptualizing this as sowing "in" or "out" of season, do acknowledge that their second crops always yield less than their first. Many of them frequently lose money on the latter, and during interviews affirmed they were hesitant to sow the second cropping cycle in the future.

DIAGRAM 1: Rice production systems in the Dominican Republic (1) Double Cropping.



Ratooning: a Viable Alternative for Double Cropping?

A ratoon is the crop produced by tillers regenerated from the rice stubble after harvesting (Cuevas Pérez, 1981, page 2). As such, it can be considered as an alternative to sowing a second cropping cycle: after the original crop is harvested, the regrowth can be managed as a second crop. The growing cycle of a ratoon is only three months, as opposed to 4.5 to 5.5 months for a sown crop.

In the Dominican Republic, farmers generally cut back the plants remaining after harvest to a height of 3 to 7 cm. After that the crop is managed as a "normal" crop, although the use of inputs is generally more limited. For instance, Nagua farmers were found to apply only half the amount of fertilizer applied to a direct seeded or transplanted crop.

Ratooning is probably most widely spread in the arid northwestern region of the Dominican Republic. Some farmers there treat their ratoons even better than their planted crops, particularly in the form of careful water management and the application of extra fertilizer. Yields of up to 5 tons of paddy per hectare were reported by farmers, as opposed to 3 to 3.5 in the Nagua region. However, yields of 1 to 2 tons/ha are common, particularly in less levelled fields.

The above mentioned data stem from case studies and a survey executed in 1983 in three Land Reform Projects: The Laguna Salada in the Mao region, and El Pozo and El Aguacate in the Nagua region. On the average, about one-third of Dominican rice production comes from Land Reform projects (Cuevas Pérez, 1983). Part of these are organized as collectives; in the remainder, beneficiaries work on separate plots about 3 ha in size. The considerations presented in the following are also based on interviews held in these areas.

Why do farmers practice ratooning? Basically, the reasons can be divided in two broad categories. Some farmers ratoon because double cropping would imply too high a risk. In the first case, farmers want to ratoon, and practice it as an alternative to double cropping; in the second, they are forced to ratroon, and practice ratooning as an alternative to single cropping. The first case is mainly encountered in the Laguna Salada Land Reform project. Apparently, ratooning is much more popular there than in the Nagua region. Part of the reason is undoubtedly the fact that, in the less favourable conditions of most of the El Pozo project and all of El Aguacate, ratoons do not produce as well as in the Laguna Salada area. Good levelling and water control are necessary to obtain a satisfactory yield in ratooning, and both these factors are constraints in parts of the El Pozo and the entire El Aguacate project.

However, even more important as an explanation for the relative unpopularity of ratooning in the Nagua region seems to be tradition. Although little is known about its origin, ratooning has been a common practice in the Mao region since the 1950's. On the other hand, in the Nagua area double cropping (although in much smaller areas than currently) has been the traditional production system, even before the construction of a major irrigation infrastructure in the 1950's.

The need for good levelling and water control as a precondition for successful ratooning was very clearly illustrated in the Laguna Salada case study interviews. Basically three categories of farmers could be distinguished: those with good conditions who practised ratooning, those with fair conditions who double cropped, and a third category with poor conditions who also practised ratooning. Interestingly, most farmers of the second, double cropping category professed that they would shift to ratooning as soon as they had levelled their plots sufficiently. However, under present conditions, ratooning did not yield enough to make it an attractive alternative for double cropping. The reason was that large patches of the stubble, which are most vulnerable just after being cut to the desired height, were affected by too much or too little water.

The third category, working under poor conditions, chose to ratoon because they were not able, or did not want, to sow a second crop because of expected shortages of irrigation water, machinery for land preparation, or credit. With a minimum investment (apart from the cutting, only some weeding and the harvest) these farmers would still obtain some benefit in the form of a few sacks of rice, mainly for home consumption.

Table 1 shows that in the Laguna Salada area, the most important reason mentioned by farmers for the preference for ratooning is its higher benefits. A cost and benefit analysis of a transplanted crop and a ratoon is presented in Table 2. Production costs are bas-

ed on data acquired in the Laguna Salada case studies; yields are the averages of those obtained by survey farmers working in good production conditions. The respondents in the AAR survey research were classified in four categories according to their most important production conditions. Here, the yields of ratoons and second crops in the top category are used.

From the data it appears that ratooning is five times more profitable than sowing a second crop. However, it must be said that the ratoon yields presented in the table, at some 80% of those of the sown crop, are relatively high. Nevertheless, even with yields of only 2.41 tons/ha in a ratoon, benefits would still equal those of a second crop.

Because the investments and the risks of losses in case of crop failure are significantly less in ratooning, and a lot less work is involved (if only in looking for and supervising machinery and labour for land preparation and transplanting), the farmers' preference for ratooning is obvious.

Marginal Production Systems—the "Riso" and the "Mateo"

Actually, the "riso" can be considered as a sort of ratoon. It differs from a "normal" ratoon in that the rice plants are left to sprout anew after the first harvest without being cut close to the ground. As a consequence, new shoots appear from the upper nodes, and not from the basal parts of rice plants. The result is the rapid development of a second crop, with yields up to 1.5 tons/ha. Usually no inputs are used, although some farmers may apply a few sacks of fertilizer. Capital investment is minimal, and sometimes nil, as harvesting is often paid in kind rather than cash.

Farmers practice a "riso" if there is no need or possibility for land preparation in a period of up to two months after the harvest —the time it will take for a "riso" to mature. Thus, in a period that otherwise would be unproductive, some additional rice is produced with a minimum investment. A "riso" is considered by farmers as just that: a way to obtain some extra rice and income in an otherwise slack period. It is not considered an alternative to growing a second crop or to ratooning. Nevertheless, in poor production conditions in which ratooning is not likely to result in reasonable yields, a "riso" is practised as a substitute for a ratoon—but only in those cases where growing a second crop is impossible.

As is to be expected from the above, "risos" are most common in El Aguacate among those farmers who only sow one crop a year. From the survey data it appeared that in some 32% of cases of farmers sowing only one crop a year, a "riso" had been "caught." This figure indicates that in El Aguacate the latter is much more common than the ratoon, which was only practised in about 12% of the instances of single cropping.

Another way of obtaining a second crop, although much less frequently encountered than either retoño or "riso," is the "mateo." A "mateo" is obtained through letting seed of the local tall variety Inglés, germinate and develop in an already established crop. Also, farmers may broadcast Inglés seeds in the established crop when it is about three months old. In both cases the very strong germinating capacity of Inglés assures that, even in the already established crop, seedlings will develop. After the harvest of the first crop, the Inglés plants have the chance to develop fully and yield a second crop. Since Inglés is a photosensitive variety, the duration of the "mateo" depends on the time the first crop is established and the Inglés seed is broadcast.

The "mateo" is only found in the Nagua region. It is usually practised when the first crop is established very late in the year—for instance in the month of July. This late date will make double cropping impossible, certainly if the farmer wants to start the first cropping cycle of the next year on time, in March-April. Since a ratoon is not feasible either, because of less favourable production conditions, the farmer may return to a "mateo." Since Inglés matures in January, this leaves the opportunity to obtain a "riso" from the "mateo." Inglés, as a photosensitive variety, cannot be used for ratooning. Nevertheless, because of the short period it takes to mature, it does yield a "riso."

Yields from a "mateo" are usually slightly higher than those from a "riso." In the case studies, yields varying from 0.7 to 2.0 tons/ha were reported (Doorman, 1983, page 135).

In conclusion, both the "mateo" and the "riso" can be seen as adaptations to unfavourable production conditions. They are usually practised because farmers have or had to wait for machinery and land preparation, water, or both. Both systems are considered by farmers to be a way to obtain some extra income and/or rice for home consumption, not as attractive substitutes for a second crop or a ratoon.

The production system based on ratooning, the "mateo" and the "riso," are depicted in Diagram 2.

A schematic overview of all the production systems discussed in this paper, in relation to farmers' production conditions, is presented in Table 3.

TABLE 1: Reasons for preference for ratooning in the Laguna Salada Land Reform Project, Dominican Republic.

Reason*	No. of Times Mentioned	%
Higher profits/lower production costs	23	34.9
No need for credit	9	13.6
Less work	20	30.3
No need for land preparation	8	12.1
Other	6	9.1
Total	66	100.0

*Each respondent was given the opportunity to give two reasons for his preference

Source: Survey of Adaptive Agricultural Research Project (1983/1984).

TABLE 2: Costs and benefits of a second crop and a ratoon in the Laguna Salada area.

	Second Crop	Ratoon
Production costs (RD$/ha)	RD$ 964.50	RD$ 359.35
Yields (Tons/ha)	3.86	3.10
Production value per ton (RD$)	RD$ 273.50	RD$ 273.50
Gross production value (RD$/ha)	RD$1055.71	RD$ 847.85
Net production value (RD$/ha)	RD$ 91.21	RD$ 488.50

Sources: Production costs (without counting farmer's own labour: AAR case studies; yields: AAR survey, category A farmers.

TABLE 3: Rice production systems employed in the Mao and Nagua Regions in relation to farmers' production conditions.

Production Conditions	Mao	Nagua
GOOD	Ratoon Double Cropping	Double Cropping
FAIR	Double Cropping Ratoon	Double Cropping Ratoon, Mateo
POOR	Ratoon	Single Cropping and Riso

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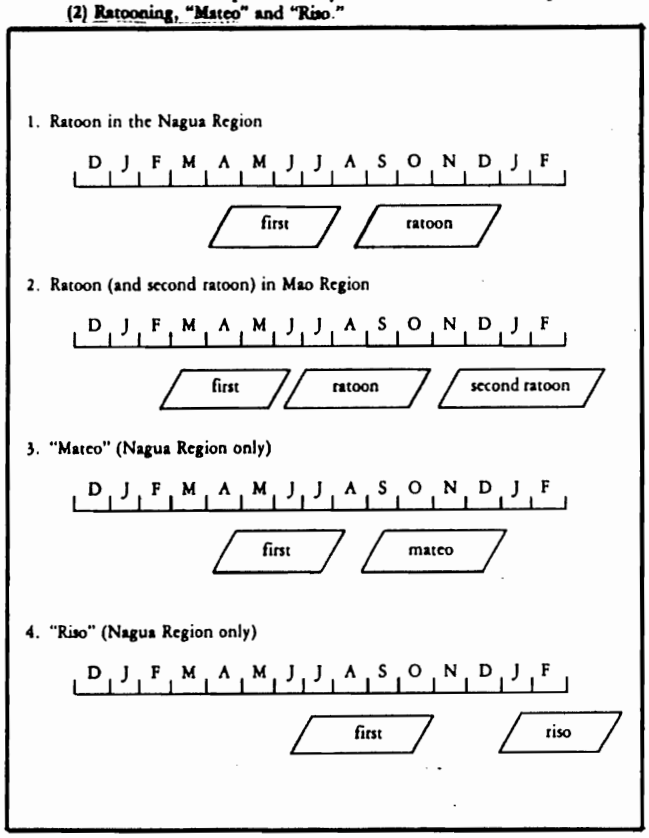
DIAGRAM 2: Rice production systems in the Dominican Republic (2) Ratooning, "Mateo" and "Riso."



The Official Standpoint on Rice Production Systems

One of the major objectives of Dominican agrarian policy has been, and still is, to obtain self-sufficiency in national rice production. To reach this goal, it is considered that double cropping should be practised as much as possible. This is certainly the case in those regions where conditions make it feasible and attainable; that is to say, where water, machinery and credit do not form major impediments. As a consequence, official opposition to the ratoon is considerable in these areas.

The "riso" and "mateo" are hardly known among researchers and extensionists, and even less among rice policy makers. Furthermore, these production systems are practised under marginal conditions, and farmers would basically agree with officials that the growing of a second crop would be preferable.

However, the ratoon offers much more opportunity for a conflict of interests. As we have seen, a reasonable ratoon yields less rice, but more profits than a second crop. The conflict will be obvious: farmers are more interested in ratooning, while officials want them to double crop.

Conclusions and Recommendations

In this paper, we have discussed four rice production systems used in the Dominican Republic. From the farmers' point of view, there are two preferences, double cropping and ratooning, which may be considered as substitutes. Two other systems, the "mateo" and the "riso," are used only to obtain some extra rice and income if a second crop or ratoon cannot be practised. That is to say, these systems are adaptations to marginal conditions, but are not to be considered as viable alternatives to a ratoon or a second crop.

The official stance on rice production systems is that maximum production should be obtained through double cropping. In this view, the ratoon is considered anathema to the objective of maximum production. The fact that considerable groups of farmers prefer ratooning over double cropping because of higher benefits and less work, is overruled in the name of the national interest of obtaining self-sufficiency in rice production.

As we tried to indicate in the foregoing, we think that considerations other than gross production levels should be taken into account before passing a final judgment on ratooning. Under specific conditions, a ratoon may be a more viable alternative than sowing a second crop. For instance, if the second crop will be sown out of season, yields may be even less than those of a ratoon which, because of its shorter growing cycle and the fact that no time is spent on land preparation, may still be harvested on time. Also, ratooning offers solutions for farmers whose crops may be affected by water shortages (although the timing in water management has to be more precise for a ratoon, requirements as far as quantity of water is concerned are less than those for a sown crop). Ratooning may also offer a solution for those farmers who see the establishing of their second crop threatened because of a lack of machinery for land preparation.

At the macro level, ratooning economizes on scarce resources in rice production, not only on machinery and water, but also on funds (credit from the state run Agricultural Bank) and expensive imported inputs.

Thus, the ratoon, under certain conditions, can be an attractive alternative to double cropping, both in micro and macro economic terms. We would, therefore, like to suggest that ratooning be given more consideration in rice research activities. Ratooning capacity could be included as a selection criteria in rice breeding. Also, agronomic research should be executed on such topics as water management, weed control and fertilization. Finally, considering the experience and excellent results obtained by some farmers in ratooning, it would seem wise to make inventory of the already existing practical knowledge on the subject.

References

1. Centro de Investigaciones Arroceras (CEDIA). 1980. 17 años mejorando la producción arrocera nacional. Secretaría de Estado de Agricultura, Santo Domingo/-Juma, Bonao, Domincan Republic.
2. Centro de Investigaciones Arroceras (CEDIA). 1984. Eclipse. Juma, Bonao, Domincan Republic. 1(4):2.
3. Cordero Mora, J.M. 1978. Areas arroceras de la Rep. Dom. Departamento Fomento Arrocero, Secretaría de Estado de Agricultura, Juma, Bonao, Dominican Republic.
4. Cuevas Pérez, F. 1980. Inheritance and associations of six agronomic traits and stem-base carbohydrate concentration on ratooning ability in rice (*Oryza sativa*, L.) PhD. Thesis, Crop Science Department, Oregon State University, USA.
5. Cuevas Pérez, F. 1983.Informaciones sobre arroz. Instituto Superior de Agricultural, Santiago, Dominican Republic.
6. Cuevas Pérez, F., y A. Núñez Jiménez. 1981. El costo de producción y la eficiencia de retoño del arroz en la Rep. Dom. ISA, Santiago, Dominican Republic/CIAT, Cali, Colombia.
7. Cuevas Pérez, F., y N. Quezada. 1977. Anotaciones sobre los arroces ISA-21 e ISA-22. Listín Diario, edition of August 6th. Santo Domingo, Dominican Republic.
8. Doorman, F. 1983. Adopción y adaptación en el uso de tecnología en la producción de arroz. Resultados del estudio de casos en el cultivo de arroz entre pequeños productores en la región de Nagua. Informe No. 1: Aspectos tecnológicos. Versión Completa.Investigación Agrosociológica sobre Yuca y Arroz/CENDA, Santiago, Dominican Republic.
9. Groot, J.P. de. 1983. Cómo evaluar el retoño en el cultivo del arroz. Centro de Investigaciones Económicas y Alimenticias, Instituto Superior de Agricultura, Santiago, Dominican Republic.
10. Scobie, Grant M., y T.R. Posada. 1977. El impacto de variedades de arroz con altos rendimientos en América Latina, con énfasis especial en Colombia. CIAT, Cali, Colombia.
11. Secretaría de Estado de Agricultura (SEA). 1981. Programa Nacional de Investigación en arroz, 1980-1982. Santo Domingo, Dominican Republic.