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WOMEN AND CASSAVA PRODUCTION

An Approach to Improving Agricultural
Productivity in Rural Zaire

A report based on the work of two
UNDP/FAO projects: ZAI/78/001 and
ZAI/81/017.

Kikwit, Zaire
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FOREWORD

This report is based on the work undertaken by the staff of two UNDP/FAO projects in the Kwango-Kwilu subregions of Zaire. The first project, ZAI/78/001, "Développement Rural Intégré du Kwilu" aimed at conducting a large scale survey to identify constraints to rural development. As a result, it became clear that nearly all food production is in the hands of women and that any effort to develop the traditional agricultural sector should focus on women and the predominant crop: cassava.

The objective of the follow-up project ZAI/81/017 "Appui au Développement Rural du Kwango-Kwilu", was to develop and test ways of improving traditional food production. These covered a wide range of innovations in the field of agronomy, extension and agricultural inputs aimed at women farmers.

The present report tries to highlight some of the special features of these experiences with a view to developing a more systematic approach to helping women farmers to improve their agricultural productivity. A detailed description of the area and agricultural practices can be found in the summary report of the survey conducted in 1979-81 "Le milieu rural et son développement au Kwilu". Other aspects have already been described at length by Clio Presvelou in her report. ^{1/} The three reports should therefore be seen as complementary.

^{1/} "Women in Food Systems" (Agricultural University Wageningen, October 1982).

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I. Women's Labour and Cassava: The Pivots of a Farming System

1. The Physical and Human Environment

The Kwango-Kwilu subregions of Zaire are characterised by a landscape of rolling table lands gently sloping from 1100m in the southwest to 350m in the north. Deep river valleys widening towards the north cut through these tablelands. The soils are very poor leached out and acid Kalahari sands, deficient in all mineral elements and in organic matter. ^{1/} However, in the central and northern parts we find a relatively richer red soil containing loamy sands, in the valleys and on the slopes.

Vegetation patterns are closely linked to these geo-morphological differences. The table lands are covered with a mostly treeless, often steppe-like savana, whereas the river valleys are lined with gallery forests where wild oil palm dominates.

The climate is humid and tropical, but cooler in the south due to the altitude. Rainfall varies between 1500 and 1600mm annually, with two rainy seasons separated by a short (mid-January to mid-February) and a long (mid-May to mid-August) dry season.

However sparsely populated the area might seem at first glance, the landscape has been profoundly changed by human intervention. The deciduous forests of the table lands have completely disappeared, and in the valleys the secondary forest diminishes every year.

The project area covers roughly 90,000 km² with a total rural population of well over 2 million (excluding the towns of Kikwit and Bandundu). 30 percent of these can be considered as agricultural population, a figure which is considerably higher than the national average. Population density (23 inhabitants/km²) is also higher than the average for Zaire (10/km²). But the population is very irregularly distributed: density can be as low as 6 in the south and over 50 in the central Kwilu. The sex ratio of the population is about 33 males for 100 females, which can be explained by the high male outmigration to urban centres. Around 45% of the population is under 15 years of age.

Nuclear households prevail and matrilinearity is the rule, whereas the household is usually virilocal. Polygamy is not uncommon (12%). Nearly 20% of the households are headed by a woman. The average household size varies between 5 and 6 persons.

There has been a noticeable decrease in birth intervals. The ratio of children per woman in an average household is rather low (2.5), because many children are sent to school in urban areas. 93% of the women consider themselves farmers. Only 35% of the women have completed primary education, and the literacy rate may be as low as 20%.

^{1/} An analysis made in 1981 indicates that all soil samples were deficient in N, 90% in K, and 38% in P. (PNE/FAO).

The size of villages varies according to the environment. In the forested valleys of the central Kwilu where the soil fertility allows a higher carrying capacity villages are large (500-1000 people), and closely built, often on watersheds. On the table lands, villages are small (300 people) and close to the rivers. A village comprises several clans and sometimes even several tribes. Most villages are relatively isolated and all information is passed on by mouth. Only 8% of the households use bicycles.

The main staple food is cassava porridge (luku), sometimes mixed with a little maize or millet, accounting for 75% of daily calorie intake. The cassava roots are peeled, soaked in water for several days, sundried and pounded. ^{1/} All households are self-sufficient in cassava production, except in the case of severe draught or cassava diseases in the south, which seems to happen periodically. The diet is rather monotonous and deficient in protein, since sources of animal protein (cattle, game, fish) are very limited locally and pulses are not grown on a regular basis (with the exception of groundnuts, of which the major part is marketed). Protein malnutrition in children seems rather common.

2. The Farming System

The mode of agricultural production is entirely traditional in the Kwango-Kwilu. Women usually obtain land through their husbands' clan, which will be reallocated annually. Only 2% of the farmers are considered non-traditional (i.e. legal title to land, use of paid labour etc.).

One of the special features of the traditional agricultural economy is that all major food crops (cassava, peanuts, maize) are also the most important sources of income. Thus, there is an immediate conflict between the subsistence and cash needs of the households.

The labour force per household has decreased with 15% since 1970, mainly due to male outmigration, and as a result the average acreage under production has diminished 10%. Men's contribution to agricultural production is extremely limited: their only task is the clearing of the forest during the dry season. In savana areas men do not undertake any agricultural work, but spend their time hunting and fishing, both of which contribute very little to the household's food supply. Small livestock are kept (goats, sheep, chicken and sometimes pigs) in small numbers, but are not looked after. Where large cattle or fish ponds have been introduced, they are the men's responsibility.

Women work on average only 15 days per month in the fields, which can be explained by traditional taboos on agricultural work (mourning, menstruation) and frequent illnesses of children or of the women themselves. However, during the rainy season the agricultural work load increases to 20-22 days a month. About 5 hours are spent each day in the fields, which are between 30 minutes and 2 hours walking from the village. The rest of the time is spent on other household chores:

^{1/} This way of processing cassava requires roughly the same labour input as its production. For more details see Jones, W.: "Manioc in Africa", 1966.

collecting water and firewood and gathering wild foods (insects, leaves, roots, berries), processing cassava and other crops. The assistance of female children is not unimportant. It should be noted that women work mostly individually: mutual assistance between women is limited because of the virilocality of the marriages (so women in the same village do not normally belong to the same clan or family). The time input per household into agricultural production can be estimated at 1562 hours per year, or 313 person-days. Of this total, 62% is the work of adult women alone, and 91% the work of women and children. Only in the case of non-traditional crops, such as rice, tobacco and coffee do men share some of the work load and responsibility.

It is interesting to note that most decision-making on agricultural matters is shared by husband and wife, with the latter deciding on the size of fields and the former on the adoption of new methods (because extension services in the past have mainly or exclusively focused on men).

The only tools available to women are one or two hoes (a small one for weeding and a large one for soil preparation), some baskets to carry produce, and sometimes a bush knife. New tools are expensive and scarce. Repair facilities for tools are often non-existent, so tools are usually in bad shape.

The acreage under production varies according to the needs of the household and the requirements of the system of "cultures imposées" (compulsory production of certain crops on certain acreages, imposed by the State and controlled by the extension service). Fields in the forest are smaller than on the table lands, an average household cultivating around 1,1 ha each year divided into two fields. With the two fields under cassava from the previous year, the total number of fields is usually four, of which only the ones of the current year are being tended. Besides the distinction between savanna and forest fields - which is only valid in the central and northern Kwilu with its forested valleys - all women have gardens near their huts for various vegetables ^{1/}, and sometimes peanuts, sugarcane or beans in monoculture. Abandoned village sites are sometimes used because of their increased fertility. In some tribal areas river gardens are also common, which are planted during the dry season with peanuts and maize and vegetables.

The cropping system is based on the predominance of cassava which figures in all major crop associations and sequences: cassava with maize, bullrush millet, peanuts and Bambara nut. Cassava has even replaced millet in some areas, because it is much less labour intensive. However, cropping patterns vary according to the environment.

In the valleys the forest is cleared by cutting the smaller trees and burning the vegetation after several weeks of drying. Maize is then planted with cassava, or peanuts with cassava, at the same time, without further preparation of the ashes. Usually the fields are given

1/ The range of vegetables is limited: many leaves are gathered from wild sources, and cassava leaves are mostly consumed. Cultivated vegetables include: *Basella alba*, *Hibiscus sabdariffa* and *H. esculenta*, *Amaranthus* spp, *Capsicum frutescens*.

a single hoeing before the harvest of the maize or peanuts. It is not considered necessary to weed or hoe cassava. 1/ Whatever the crop in the first rainy season, cassava is planted or remains in the field during the second rainy season, after which the field is abandoned. Harvesting of one or two tubers per plant continues for up to 20-24 months, but no maintenance will be carried out. In the forest the cassava plants on fallow fields may be harvested irregularly for several years. The field will slowly turn into secondary bush and will be left fallow for ten years at the most. It must be noted, however, that fallow periods are shortening considerably in the last decade and in many instances forest fallow of no more than 4 years have been observed. In the proximity of Kikwit town, permanent cultivation of cassava occurs in former palm groves and soil degradation is reaching a critical stage. Forest shifting cultivation fits into the cut-burn-plant-hoe classification (Miracle, M. "Agriculture in the Congo Basin", 1967).

In the savanna burn-hoe and cut-plant prevails, depending on the ethnic group, with cassava-millet or cassava-peanut-Bambara nut as the most common associations. The grass is burnt and mounds and ridges are made of varying sizes, usually on the top of the plateau or on the slopes, where they follow the slope, thus causing severe water run-off and gully erosion. In few cases, savanna grasses are dug into the mounds or ridges. Again, only one weeding is considered necessary, and cassava is left as long as needed. Minor crops are grown on the edge of the field. A slightly different technique is used in the case of onions and Irish potatoes, which are locally important as a cash crop: after cutting the grass is gathered in heaps on one side of the field and burnt, whereafter the crops are planted in the ashes without further hoeing. In any event, the amount of grass to be burnt or dug in is very limited due to the frequency of spontaneous or intentionally lit bush fires, thus aggravating the natural deficiencies of the soil. This is probably the reason why the fallow is always opened up with cassava which one would normally expect at the end of a crop sequence. In the same way, it is most likely the explanation why the crop sequence is so short (only 2 seasons: September to January, and February to May) and completely tied to the cycle of cassava.

In forest or savanna, cassava is planted in a similar way (though one only finds ridging in the savanna): cuttings of 70-150 cm length are laid horizontally on the soil and covered with a little earth. Spacing varies but is usually very wide (2-3 m in all directions) with a maximum of 3000 plants/ha in the forest and often 3000 in the savanna. 2/ Several cuttings are planted in a parallel or crossing pattern at any one place. Many local varieties of cassava are known, probably over 30, with separate names in the different tribal languages. In fact, women always plant a mixture of varieties on the same field,

1/ In fact, some common weeds (e.g. *Talium triangulare*) constitute a source of vegetables and are regularly harvested, but this is not considered weeding. It should therefore not be recommended to control all weeds irrespective of their use.

2/ The low densities are partly intentional and required for mixed cropping, but partly they result from poor management techniques (diseased or badly stored cuttings that do not grow).

so that "some varieties will always yield sufficient tubers". Bitter varieties are preferred to make luku, but sweet varieties are grown in small numbers for immediate consumption. Both late and early maturing varieties are planted to extend the length of the harvesting period. The knowledge of varieties is exclusively a woman's domain. Diseases and pests are very common, mostly Bacterial Blight (CBB), Mosaic Disease (CMD), Anthracnosis Disease (CAD), Green Mire (CGM), Mealy Bug (CMB), and Phytophthora root rot. It is seldom that one finds a field without multiple infestation. Women have great difficulty finding disease free plant material. Tubers are harvested according to the household's needs over an extended period, starting as early as at 8 months. 1/ Cassava leaves are the most important source of green vegetables and are consumed nearly daily. They are harvested from 2-3 months onwards and are also an important cash crop. Without doubt, the frequent harvesting leads to a decrease in tuber production, and perhaps also to a higher susceptibility to diseases and pests.

Cassava root yields are low, on average 4 T/ha (fresh tubers), but vary between 16 T in best forest conditions and 0.5-2 T on frequently burnt savana. Estimations of the percentage of the total production consumed by the household itself range between 60-80%. 2/ Annual cassava consumption per head, including the losses during processing, can be estimated at 220 kg of dried tubers. 3/ Cassava cassettes are not stored in great quantities at household level; flour and fresh roots are never kept overnight.

The sale of agricultural products accounts for more than half of the average household income. The sale of cassava alone contributes 43% of the total income and 95% of the income from agricultural sources. 4/ In over 60% of the cases, a woman is responsible for the marketing (carrying and sale) of crops, but in 93% of the cases she is supposed to give nearly all her income to her husband, who then decides on its use.

As a conclusion it can be said that the shifting cultivation patterns in the Kwango-Kwilu are characterised by a nearly exclusive female labour input, the predominance of cassava, and, therefore, of a rather labour extensive mode of production. Gathering remains an important source of food and in some ways the production of cassava is more similar to gathering than to agriculture. Methods of production are entirely traditional, but there is considerable variety within and between ethnic groups and villages. Female labour productivity is low. As such, the area presents an interesting case to illustrate the possibilities of agricultural and social change.

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- 1/ Yield estimation in the traditional situation of prolonged and irregular harvests of both roots and leaves requires special assessment methods which will not be discussed here.
 - 2/ Calculations of data for 1991 indicate a slightly lower percentage, as expected: 55%. ("L'Agriculture de la Province de Leopoldville", INEAC, 1992).
 - 3/ 100 kg of fresh tubers yielding approximately 35 kg of cassettes and 30 kg of flour.
 - 4/ Average figures from the 1980 household budget survey; there are of course, some differences between the zones and tribal groups.

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 - 3/ 100 kg of fresh tubers yielding approximately 35 kg of cossettes and 30 kg of flour.
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II. Constraints to Cassava Production: Factors Associated with Low Productivity

The foregoing description of the farming system of the Kwango-Kwilu has deliberately been a static one. It is now time to examine recent changes in cassava production. Average cassava yields per hectare have dropped from 12 T in 1958 to less than 5.5 T in 1981. The survey carried out in the project area aimed at explaining this decrease and at identifying farmers' 1/ needs and priorities in the field of agricultural production.

It became evident from the onset that farmers are very much aware of the decline in cassava production. They also indicated that their main problems are of an agro-economic nature (low prices, marketing bottlenecks, low yields, insufficient food supply for the household). This has provided a starting point for the experiments discussed in Chapter III.

Generally speaking, the factors associated with the decline and the overall low level of cassava (and other agricultural) production can be summarized as follows:

1. Soil fertility and its decline: The fragile soils of the Kwango-Kwilu are among the poorest soils of the entire Congo Basin. Population increase and a settlement policy dating from before Independence have led to a high concentration of people in some of the more fertile valleys, leading to a systematic shortening of fallow periods and to destruction of the forests. With the decrease in wild animals, men started to burn larger areas of savanna and forest repeatedly throughout the year in an attempt to continue hunting. Organic matter on fallow plots is thus destroyed and soil fertility cannot rebuild. No alternatives have been developed for the traditional long fallow without external inputs to restore and improve soil fertility. Anti-erosive ridging or even mulching are little known. We must conclude that present cultivation patterns are not adapted to the new ecological situation of high population density, disappearance of forests and short fallows. It is very significant that the shortage of firewood in some areas leads to the use of old cassava stalks for cooking fires.
2. The system of "Cultures Imposées": Through enforcing a certain acreage for each major crop, this system encourages extensive cultivation methods, inadequate selection and rotation of plots and the creation of large monoculture fields, thus enabling diseases and pests to spread. 2/ There has been an important change in cultivation techniques during the past generation. Women report that in contrast to their grandmothers and mothers they have no time to dig in grasses, hoe and weed properly, because the fields are too large. In some cases, repeated burning at the beginning and end of the long dry season and during the short dry season as well has been observed: although some women are aware of the loss of soil fertility through burning, they practice it to facilitate clearing and hoeing.

1/ "Farmers" and "women" will both be used to designate rural women with a main responsibility for food production.

2/ For more details see: Fresco, L.: "Des Cultures Imposées aux Cultures Encadrées". Zaire-Afrique Janvier 1982.

3. The incidence of pests and diseases: As a result of the loss of soil fertility, and extensification of cultural practices, disease and pest attacks have greatly increased. Mosaic virus in cassava has already been a source of concern before independence and resistant varieties have been introduced in the Kwango. Today, nearly all fields are infected with several new diseases and pests. A clear link can be established between cultivation techniques (including the choice of fields) and the attacks. Cassava grown on fields with better soil, in forests and valleys with adequate ridging, planted at the beginning of the rainy season, in particular intercropped with legumes, seems to be in a much better phytosanitary condition. Rainfall has also its impact: in 1981 which had a severe dry season entire fields were devastated, while 1982 fields yielded well throughout the very rainy dry season. The local varieties react in a different way to diseases and pests. A major constraint seems to be the availability of disease-free cuttings.
4. Unfavourable agricultural prices: There has been a dramatic worsening of the terms of trade between the agricultural and industrial sectors in Zaire. Until mid-1982 agricultural prices were fixed by Government, and the official minimum price was usually interpreted as a maximum by merchants and farmers alike. As a result of lowering relative prices and the gradual yield decrease that occurred simultaneously, the traditional cropping calendar has been greatly upset. Women have developed a tendency of harvesting cassava earlier and earlier starting now often at 7-8 months after planting. This in itself has led to a yield decrease and a negligence of cultivation practices. Since cassava harvesting is continuous throughout the year - with a decrease in November when heavy rains make drying impossible - women are thus compelled to plant fields earlier too, i.e. at any time when current fields of the previous and current years are exhausted. Therefore, planting dates are shifting from early wet season to late wet season and even early dry season. In combination with an extensification of cultivation practices this has had quite a disastrous effect on overall yields. The low relative prices for agricultural products, as well as general marketing constraints (lack of merchants, irregular buying, impassable roads etc.) have probably also a negative effect on production. Farmers, especially in isolated communities, have focused primarily on their subsistence needs. However, with the completion of the tarred road from Kinshasa to Kihwit, and with the funding of road improvements in the area assured marketing as such cannot be considered problematic.
5. The absence of a distribution system for agricultural inputs: This explains that minimal outside inputs are used by farmers. Traditional tools are difficult to obtain because village blacksmiths lack inputs themselves. Imported tools are expensive and only available in towns. Fertilizer and improved varieties exist in small quantities throughout the country but they do not reach women in the Kwango-Kwilu, who don't know of their existence anyway, and could not afford them.
6. The lack of knowledge of alternatives for the existing cropping system: Although INEAC ^{1/} has undertaken some very thorough

^{1/} Institut National pour l'Etude Agronomique au Congo.

research work, little of this knowledge and few varieties have been applied after Independence. Present research efforts by national programmes focus on the breeding of particular crops (maize, rice, cassava) and do not usually take into account the traditional farming systems. ^{1/} Very little recent work has been carried out on poor sandy soils. Yet, the overall alternatives seem clear: introduction of legumes in rotation with cassava (especially *Cajanus cajan*, *Vigna unguiculata*), improving groundnut varieties, and introducing rainfed rice production in the valleys.

7. A very ineffective agricultural extension service: Although a network of extension agents (*moniteurs agricoles* and *agronomes*) exists reaching down to the lowest administrative levels, this service is not only ineffective but has often even a negative impact on agricultural production. The role of the extension agent in Zaire is not to counsel farmers or to transmit technical knowledge but, on the contrary, to control the application of the "Cultures Imposées", by checking fields, and to collect statistics on prices and volumes marketed. At the same time, he is often involved in tax collection and other political and administrative matters. He, because without exception, all *moniteurs* and *agronomes* are male. Their training is usually limited and theoretical. They are irregularly and lowly paid. It is not surprising, therefore, that farmers regard them with outright suspicion as government agents who are only trying to supplement their incomes. As a result, there is no assistance whatsoever to farmers in the field of food production with the exception of some regional development programmes (not in the Kwanza-Kwilu) and non-governmental agencies (NGOs), mainly Catholic missions, who have introduced crops like soy bean and upland rice.
8. A low degree of farmer organization: Not only do women work mostly individually, but no organization exists in rural areas to give women (and men) any countervailing power or even access to farm inputs. Women, and farming, could benefit from joint efforts, e.g. in the field of marketing, prevention of post-harvest losses, processing, management of the village's natural resources.
9. The absence of male labour from agriculture: As explained in the First chapter, men only assist in the clearing of the forest during the dry season. Two other aspects need to be discussed here. One is that, if agricultural prices and the general marketing situation improve, while job opportunities and income earning for semi-educated men remain very marginal, it should be expected that men will become interested in agriculture as an alternative to more precarious employment. In the more developed areas of the central Kwilu one can already note their interest in cash crops (coffee, tobacco) and in high yielding food crops that are little consumed by the household (soybean, rice, to some extent maize), but never in cassava since that is considered exclusively a woman's crop. The impact on traditional food production and on women's work needs to be investigated if this becomes a general tendency. At present, it would appear that these crops take away the best soil, especially forested slopes and valleys, from food production, and probably in the first place from cassava as it is the crop that will still yield on the poorest soils. Also, women are supposed to assist men in the more labour demanding tasks of

^{1/} See: "Cassava Improvement in the Programme National Manioc in Zaire: Objectives and Achievements up 1978", H.C. Ezumah. In: Tropical Root Crops: Research Strategies for the 1980s. Ed. E. Terry. 1981. IDRC.

weeding and harvesting cash crops, while they still continue to be responsible for traditional agriculture. The second aspect concerns the introduction of large cattle raising and, to some extent, of fish ponds. Although few villagers are able to afford the initial investments of buying cattle, and notwithstanding the limited success so far of cooperative herds initiated by the missions, livestock can become the most interesting opportunity to give men an economic role. If cattle are properly tended - and this supposes the diffusion of technical skills and inputs such as salt stones, preventive spraying, which are now only available in a very limited way - the rewards are high, all the more because the herds can be kept on the poorest and most depleted soils (allowing 5-7 ha per head of cattle, of course, but this is no problem in the sparsely populated southern areas) and do not require a labour input from women. As a fringe benefit women could use the manure for food crops, which can be collected easily from the "kraals" where the cattle are kept at night. Animal traction, of course, constitutes the long term solution to many of the issues discussed here.

These factors associated with low levels of cassava production and female labour productivity, have become the focus of the project's thinking about their own interventions. It should be mentioned that, contrary perhaps to other parts of Africa, the main bottleneck is not that women do not have access to the same agricultural innovations as men, but rather that no innovations are available to small farmers and that nearly all small farmers are women. It was with this realization that women are therefore essential to the implementation of any development strategy for the Kwango-Bilu, that the projects undertook their work concentrating on women and cassava. Ideally - given unlimited means and time - the focus should have been laid on all of the following areas:

- reduce women's work load while improving their agricultural productivity and introduce labour saving techniques for household tasks ^{1/} with a view to both freeing their burden and increasing production;
- improve traditional cultivation techniques without relying too much on outside inputs and without upsetting the fragile ecosystem; including an inventory of past research on shifting cultivation;
- increase male participation in the rural economy without creating negative side effects for women;
- provide new orientations for extension and agricultural research.

In practice the projects' resources and personnel were far too limited to tackle more than a few of these problems that were within their immediate reach, such as the improvement of cultivation techniques. But that in itself turned out to be a much more complex and challenging field than expected.

^{1/} In contrast, most projects aim at increasing labour productivity so that with the same labour input a higher production level is reached.

III. Variations on a Theme: The Design of Experiments

1. Women's Practices and Criteria

The first step in improving cultivation techniques has been to compare variations in existing patterns between women and between villages with a view to defining practices that make more successful use of the same ecological environment. Why do some women on some cassava fields have higher yields and fewer diseases than others? Or in other words: is there any room for improvement within traditional cultivation practices?

Careful observations of fields throughout several growing seasons and discussions with village women of different generations have led to the conclusion that certain cultivation practices and the use of certain varieties account for a large proportion of the higher yields achieved by some women. Of course, individual characteristics play also their role, such as a woman's strength and age, her regular presence in the fields (because she or her children are healthy), the care and commitment she displays, etc. However, many more technical aspects of what will be called "successful" cultivation practices ^{1/} may be defined and transmitted to other women. Among these are:

- location of the fields: at the bottom of slopes and in depressions, after long fallow;
- planting dates: in the first part of the wet season;
- use of shorter cuttings and the selection of cuttings from healthy older plants;
- thinning of young plants;
- soil preparation: digging in grasses, mounds or ridges in the beginning of the dry season;
- densities: only 1-2 cuttings at any place with proper spacing (1-2m);
- mulching;
- timely weeding, especially during the first months;
- crop associations, with pulses (*Voandeldeia subterranea* groundnut, *miébi*).

It should be noted that these cultivation practices are genuinely "variations on a theme": they do not require significantly more work or other inputs that are not within every woman's reach (with the exception perhaps of the qualities associated with certain fields and soils).

^{1/} Most of these are practised by BaPende women who have the most elaborated agricultural tradition of the Kwango-Kwilu.

An inventory has been made of local varieties of cassava and their characteristics (yield, susceptibility to diseases and pests, etc.). Women themselves classify varieties according to their fitness for forest or savana. Moreover, women are very eager to experiment with new varieties and will do everything to obtain new cuttings (travel far, or even steal them from the projects' fields!). Great variation has been observed between local varieties in disease and drought tolerance, tuber and leaf yields, taste etc. The discussions with the women also permitted to define their criteria for the selection of "best" varieties, which go well beyond the standard criterion of researchers: high tuber yield. Women's criteria for the selection of cassava varieties include:

- tuber, and equally important, leaf yield;
- high dry matter content of tubers (i.e. higher flour production):
- rapid formation of leaf canopy (reduces weeding, and gives an early vegetable yield);
- taste: bitter varieties are preferred for luku flour;
- dwarf varieties of which the leaves can be easily picked and which do not suffer from wind damage during the dry season;
- late flowering, because leaves are usually harvested up till the flowering which is said to change the taste;
- shape of tubers: regular shapes are easier to harvest; short and fat tubers do not break when the plant is lifted, and they are easier to peel;
- drought and disease/pest tolerance;
- a combination of early maturing and late maturing varieties in order to assure a continuous tuber supply and to spread risks of infestation.

In themselves these discussions about cassava cultivation have proved to be a very valuable method to help women to become aware of their possibilities to change matters that are traditionally (and also often by development experts) considered as immutable.

2. The Contribution of Existing Agricultural Research

It was also attempted to make an inventory of past and present research on cassava production on acid sandy soils. However, apart from some work by INEAC before 1969, little present day research by the Programme National Manioc (PRONAM, with is backstopped by IITA) provides immediate solutions for the problems of cassava in the Kwango-Kwilu. The reason is that most research is either carried out in stations or on more fertile loamy soils which are not at all representative of the Kwango-Kwilu environment. Thus, the gap between research station and farmer yields seems only to widen. Most of the research has concentrated on breeding of "resistant" varieties that are also high yielding, but without taking into account the traditional farming systems nor farmers' priorities. As a result, the varieties developed so far have not been introduced at all, or have not been accepted by farmers

or have not yielded significantly better 1/ than most local varieties on the table lands, and they do not respond to farmers' criteria: e.g. varieties that have a sweet taste, attain a height of over 2m after 6 months, flower after 7 months, produce few and small leaves and very long rather thin tubers. Moreover, all trials so far have been carried out with management methods very different from those of women farmers: e.g. mono-culture, no leaf harvesting at all, one final tuber harvest after 12 months. Their yields cannot be compared, therefore, to local varieties grown with traditional cultivation techniques.

Joint trials have been carried out with PRONAM to compare local and improved varieties grown on sandy table lands under different cultivation practices. 2/ Six PRONAM varieties selected for that environment, together with two "most successful" local varieties identified by women farmers, have been grown in three different centres. Two aspects of cultivation techniques have been compared: (1) site (on top of table lands; on slope: in valley) and (2) ridging with digging in grasses and ridging with burning the grasses. Rating for diseases was carried out every three months. Four replications of each variety and each treatment were included. Although PRONAM and the FAO project with the local Catholic mission supervised the trials, all practices were discussed in detail with the women who also carried out most of the work. Maintenance and soil preparation reflected "best" local cultivation practices previously identified with the women. For reasons of comparison with other PRONAM trials the standard procedure of monocropping of tuber harvesting at 12 months without any leaf harvesting was used.

The results are summarized in Annex I. It may be concluded that yields are generally very high as compared to local averages (4T, with 7T as the trial average). However, there are great differences between the varieties. F100 and F162, two PRONAM varieties, display overall maximum yields, closely followed by the two local varieties (F162 has a greater standard deviation and is less stable in its high results). In villages where these local varieties exist, multiplication can be undertaken immediately by farmers. Although the trials do not demonstrate that the digging in of grasses is beneficial - despite very clear indications in other experiments and on women's fields - the high yield levels can be explained by the particular package of cultivation practices used ("best local techniques") as well as by the higher density (10 000 plants/ha and monocropping), and, of course, by the absence of leaf harvesting. Site selection has a clear influence on yields. In one village the yield proportion between table land, slope and valley was even 1:2:4, independently of the variety. This confirms all observations on women's fields. Notwithstanding the improved cultivation practices and the use of "resistant" varieties, all fields have been attacked by a combination of diseases. F100 and the local varieties are least attacked. A negative correlation between yield level and average disease incidence index has been established for each variety.

1/ Figures in the 1979 Annual Report of PRONAM indicate an average yield (fresh tubers) of their varieties of only 3 T on sandy table lands, which is no more than the average of most local varieties and significantly less than the highest yielding local ones.

2/ For a detailed description see "Améliorations dans la production de manioc sur sols pauvres" FAO-PRONAM-SDD Kikwit, November 1982.

3. The Experimental Approach

It has been necessary to design experiments that aimed at testing:

- how the most successful traditional cultivation practices could be adopted by other women and still remain successful.
- to further explore variability in women's production techniques;
- the performance of improved and local varieties under traditional, "best traditional" and "modern" management techniques, and the reasons for a possible yield gap;
- what type of extension and social organization would allow the dissemination of improved cultivation practices, in view of the ineffectiveness of present extension services;
- what other factors associated with women's low labour productivity, such as her household tasks, could be tackled simultaneously.

The experimental approach needs to be emphasized as it has evolved quite spontaneously out of the projects' activities. Since a valuable research and development (R&D) system exists already among women 1/ carrying out experiments with them on their fields constituted a logical sequence. The experiments focus on testing under real conditions, i.e. taking into account the complex of all factors - technical, social and economic - that influence cassava production. This excludes the assessment of the contribution of each of these factors alone, but allows the assessment of packages or clusters of factors. This is not considered a handicap since it is usually impossible in development work to intervene only with respect to one single factor. Thus, behavioral and economic aspects are combined with agronomic factors with a view to changing the management of cassava. 2/ This approach contrasts sharply with research station trials that mostly aim at understanding single or few technical factors in a situation far removed from farmers' realities. It is critical that the experiments be managed by women themselves. Not only do they participate in deciding what features will be tested, but they decide themselves on the location of their fields, the cultivation practices and their timing. Carrying out the work and managing the trials is in itself a learning experience. Their evaluation of the performance of varieties and the feasibility of new techniques has been decisive for the project.

Two types of experiments were designed: one to develop and introduce new technology, and one to test new forms of organization of the diffusion of knowledge and technology. New technology comprised a package of most successful local techniques for the growing of cassava, "best" local varieties and PROMAP's tolerant varieties, new hoes for soil preparation, simple maize shellers, and firewood species in combination with anti-erosive measures. On the organizational side,

1/ That this is not exceptional is confirmed by S. Biggs "Le paysan et la recherche" in Ceres July-August 1980.

2/ In a similar way the subject matter of this paper reflects the borderline between agronomy and social science: the relationship between crops and man/woman.

attempts were made to introduce a network of "animatrices", women farmers who assist their colleagues in applying new techniques; to work through existing NGOs, especially RC missions; to give in-service training to agronomes of the Department of Agriculture on cassava growing and the preservation of natural resources.

The experiments combined different elements of each type according to an assessment of the needs of a particular area. The ecological environment of the poor table lands was more or less constant, and many replications were included. Detailed descriptions of all experiments cannot be given here, and they are not considered essential to understand the approach.

IV. Institutionalizing Innovations: The Impact of Experiments on Extension and Research

The evaluation of the approach and of each single experiment can only be completed with time, but some conclusions may be drawn with regard to the most important areas of action. The creation of institutional linkages has been a foremost concern because it was clear from the beginning that the projects' limited resources called for a close collaboration with existing institutions.

1. Cultivation techniques: Techniques that do not make excessive demands on labour but consist on rescheduling the agricultural calendar (cassava planting after the sowing of peanuts in October), timely weeding, ridging, using short cuttings etc., appear to be acceptable and successful in raising yields. Digging in grasses early during the dry season requires some extra labour (which, hopefully, would come one day from the men, as one animatrice said); but comes at a moment when there is little other work. Women seem to be convinced of its effects. However, the main bottleneck is the lack of grasses because of burning by the men. In fact, there is a structural conflict between men and women with regard to the utilization of natural resources: men burn savana and forest to hunt, thus creating a loss of soil fertility and firewood and, in the long run, the drying out of springs, all of which are essential to women. Men also own goats, and sometimes cattle that often damage the crops. If men are involved in agriculture, they grow cash crops on the best land, leaving women the depleted soils for food production. There does not seem to be a short-term solution for this conflict unless men actively engaged in a more permanent agricultural/pastoral production system. It cannot be measured quantitatively after such a short time what the impact of improved techniques is on overall cassava production in the region. The question of who decides on the utilization of the surplus revenue has not been answered either, but the fact that women are eager to adopt the new techniques suggests that they expect an immediate benefit for themselves, as with an increased cash income women can continue to supply their husbands with an equal amount and keep the surplus for themselves. Successful intensification of production techniques also requires a political solution for the system of "Cultures Imposées", allowing women to concentrate their efforts on smaller acreages.

2. Reafforestation and fallow: It is known from past research and present trials that legume cover crops (in particular *Crotalaria* and *Centrosema* spp) and reafforestation with *Eucalyptus* spp (especially *E. alba*, *E. camaldulensis* and *E. citriodora*), *Acacia auriculiformis*, *Gmelina arborea* and several local species is technically very successful. In fact, simple protection against bush fires of the savana on slopes bordering the last gallery forests will allow a dense deciduous vegetation to develop within a few years. A central nursery has been established in Kikwit, distributing reafforestation and firewood species to villagers and NGOs. However, the problem of improving rotations and fallow periods in the traditional cropping patterns has not yet been addressed. It would seem that women are more aware than men of the need to restore soil fertility and of the depletion of firewood sources. It is recommended that they be the target group for future environmental programmes. The introduction of fruit trees has not been very successful in the past; in view of the multiple uses of many species, this possibility should again be investigated.

3. Varieties and multiplication: It is probable that two PRONAM varieties perform well on the table lands, if we look mainly at tuber yield. These two varieties, alongside the best local varieties are currently being multiplied and some 12 000m have been distributed already. It appears essential that multiplication be carried out in a decentralised manner: ideally each collectivité (the lowest administrative level: 25-30 villages with around 35 000 people on average) should have its own multiplication fields. This avoids costly transportation of bulky cuttings, allows for careful adaptation of varieties to the specific ecological conditions, so that the fields can at the same time be demonstration and trial fields for cultivation techniques, and gives farmers greater control over plant material and selection. A three-level selection and multiplication system has so far proved appropriate: (i) at the projects' research centre, (ii) at secondary centres (missions, agricultural schools) and at collectivités, and (iii) at village and farmer level.

4. "Animatrices": A network of information sharing and testing by women under the informal leadership of an "animatrice", seems successful if they are chosen by the community as a whole for their farming and personal skills. The best animatrices are probably the "Kawuma", women of the BaSuku tribe who are traditionally responsible for indicating the best land and the activities according to the cropping calendar to other women - but this institution does not exist elsewhere. Animatrices do not receive a salary, but only some benefits in kind (tools, seeds) and travel expenses for training sessions. This seems satisfactory till now. Their range of action is limited to their village of residence, where their fields may constitute a kind of permanent demonstration plots. Most exchanges of experience and information take place while women are visiting each other or walking to or from the fields or the source. Animatrices do not conduct extension meetings in the formal sense. They receive their training during a period of apprenticeship with another animatrice. Their work benefits from the use of teaching aids, which the project is currently finalising: a slide series, posters, a handbook in the vernacular, and which have a strong female and small farmer bias.

5. Government extension service: Women farmers do not benefit from agricultural extension programmes at all, and the extension agents' attitudes and official tasks constitute often a constraint. A re-definition of the extension service is urgently required to allow it to become more women-oriented through the involvement of women staff and the dissemination of technical improvements in food crop production. Proposals have been made to define new roles for each member of the extension team at collectivité level: one person for statistics, whereas the rest of the team will specialise in food crops, fish farming, small and large livestock, rearing/assisted. It will be required that the extension agents live in the villages and not in the collectivité Headquarters, and that they walk out to the fields, because during Government working hours only men can be found at home. Political decisions are again necessary to free extension agents of their administrative burden. The problem of the recruitment of women is not easily solved since hardly any qualified women are available now or in the near future. It is not advised to recruit women with a home economics background, were they available, because rural women's first priority is the intensification of their food production. Where possible, of course, women agronomes and monitorices should be recruited and integrated in the collectivité team. As a temporary measure, it is suggested to complement the team's activities by the work of voluntary "animatrices" whose role should be officially recognized by the Department of Agriculture. On the other hand, it

is strongly recommended that some women be appointed at high levels within the Department of Agriculture, Rural Development and Environment with special responsibilities for the planning and evaluation of extension programmes. It should be noted that the training and change in attitudes of existing male staff needs to continue. In-service training should not only comprise subject matter training but also training in communication and extension methods. For women staff training course should perhaps take place separately in the beginning, in view of their relative disadvantage in experience and training and thus training needs. The reactions of male extension staff have so far been very positive. It is hoped that they will soon be equipped with some teaching aids and office supplies. It will also be necessary to coordinate messages, services and inputs at the extension level so that extension agents can assist farmers to integrate these without conflict. They could assist in the distribution of seeds, cuttings, fertilizer as well, if this does not interfere with their counseling role and if it allows sufficient farmer control.

6. The NGO network: The need and benefits of working closely with NGOs, and in particular the missions, deserves to be emphasized. They work at grassroots level and continuity is more easily guaranteed. Their work is often complementary to that of government agencies. However, most NGO activities for and with women are limited to encouraging a traditional western style household role for women. It has been the projects' experience that it is possible to help the NGOs to assist rural women adequately. It will be necessary to strengthen their programmes by supplying inputs (cuttings, tools, etc.) and training for male and female staff.

7. Tools and processing: Several models of hoes have been tested and it appears that women prefer the smaller model of an industrially made hoe (+ 0.6 kg), but for those areas where women use a very large round hoe. Ways of distribution of the hoes at a reasonable price through merchants and the NGOs are currently being investigated. Experiments with innovations in crop processing show that simple maize shellers are successfully adopted and can be produced locally from freely available aluminum scraps at a price that women are able to afford. A contract has been signed with the technical school in Kikwit for production and distribution. Models of peanut shellers adapted to the small grains are being developed and tested. However, the reduction of labour inputs into cassava processing (about half of the total labour input) has not yet been addressed, although some progress has been made with improved drying boards. This problem becomes certainly urgent with increased production. Proper storage of cassava could help women to benefit from seasonal price rises, especially in October - December when cassava cannot be dried and prices increase dramatically.

8. Agricultural research: It becomes apparent that without a focus on women's agricultural work and small farming systems, no solutions may be found for the current serious problems in the agricultural sectors of the Kwango-Kwilu (and other areas), in particular for the decrease in cassava production. It is imperative to develop agricultural technology which is relevant to farmers as soon as possible. Unfortunately, most research has developed recommendations which are technically sound but not applicable by farmers. In fact, the majority of cassava research has focussed on cassava as an industrial crop and not on its use by small farmers as a food crop. Concern for protein levels and toxicity in cassava have not yet yielded innovations at farmers' level. So what would be the alternative for the present

agricultural research structure? This question merits of course far more than the few lines here, but some principles may be spelled out. While there is a need to have national level programmes that specialize in particular crops and their genetic improvement (as they exist in Zaire today), it is of utmost importance that these be integrate at the level of the Région and below, where preliminary results can be tested in several ecological contexts with farmers, which will be fed back into the national programmes. But the messages to be extended should be defined at farm level (not at individual farms, surely, but at the farm level in this system). Farming System as a discipline would make a most useful contribution here in helping to (i) define new technologies appropriate to the needs and capacities of local farming systems, (ii) plan and manage area based development programmes, and (iii) to orient research policies towards a reconciliation of local and national priorities. 1/

To conclude this paper, a few final remarks concerning development programmes with a focus on women. Firstly, one may ask whether in the case of the Kwango-Kwilu it would have been more suitable to formulate a separate women's project or component next to a general applied research programme on food crops. The answer should be negative, because (i) it has been essential to the development of the new cultivation techniques that women be involved at all stages of the applied research, (ii) an exclusive women's project would discriminate against the few men farmers who try to help their wives in crop production and would have had much less leverage with the Agriculture Department, and (iii) it would go against the integration of livestock and food production which seems to be the only viable long term solution for the area. But the question which cannot be answered yet is: can men be persuaded to assist women in the intensification of their cultivation techniques, such as ridging, mulching, better land management, without negative side effects for women (loss of status, income or control over resources)?

Secondly, the issue of replicability should be raised: to what extent should and could these improved cultivation techniques be applied in other cassava growing areas? The approach has been closely linked to the staff of the projects and in particular to the combination of an interest in small farmer agriculture with a focus on women. On the other hand, replicability may not always be desirable, because the process of developing new cultivation techniques starting from existing variations is in itself a necessary step in the change process and should not be omitted.

Last but not least, to avoid all confusion, it must be stressed that by a focus on simple technologies it is in no way suggested that women have access only to minor technological innovations and that the true break throughs in agriculture should only be handled by men.

1/ See the proceedings of the IITA workshop on "On Farm Experimentation", June 1982.

Annex 1: Production in T/ha (fresh tubers) and disease incidence 1/ according to variety and location/site of field

Location / Site	F 100 A	F 150 R	D 149 C	F 162 D	F 112 E	30577/5 F	Local 1 variety G	Local 2 variety H	X/Site
LOFO tableland	3.6 T	2.3 T	1.05 T	2.7 T	0.8 T	0.95 T	1.45 T	1.05 T	1.74 T
diseases 1/ slope	1.8	2	2	2.4	2.2	2.2	1.8	2	
diseases	7.15 T	4.6 T	1.05 T	6.4 T	7.45 T	1.1 T	3.1 T	2.65 T	3.44 T
valley	1.8	1.8	2.4	2.2	2.2	2.2	1.8	1.8	
diseases	11.35 T	8.55 T	2.15 T	9.15 T	5.55 T	2.25 T	5.35 T	7.65 T	6.59 T
	1.8	2	2.2	2.2	2	2.2	1.8	1.8	
MOSAMBO tableland	5.35 T	2.1 T	1.05 T	2.7 T	1.2 T	1.7 T	1.85 T	3.1 T	2.38 T
diseases	2.2	2.2	2.4	2.6	2.2	2.6	2.4	2.2	
diseases	9.2 T	5.5 T	3.9 T	8.7 T	2.9 T	3.7 T	3.7 T	3.1 T	5.08 T
valley	8.6 T	8.45 T	2.25 T	11.4 T	7.3 T	4.5 T	5.65 T	7.55 T	6.98 T
diseases	1.8	2	2.2	2.2	2	2.4	2	2.2	
KINGUNGI tableland	13.9 T	17.2 T	7.8 T	15.9 T	14.8 T	10.2 T	12.8 T	10.4 T	12.8 T
diseases	2.2	2.2	2.6	2.4	2.2	1.8	2.2	2.2	
diseases	12.6 T	10.8 T	-	-	16.4 T	11.8 T	24.9 T	17.05 T	11.9 T
valley	2	2.6	-	-	2.2	2	2.6	2.6	
diseases	12.55 T	11.25 T	2.25 T	7.7 T	13.65 T	10.25 T	14.25 T	15.85 T	10.96 T
	2.1	2.2	2.6	2.2	2.4	2.4	2.4	2.4	
TOTAL prod/var in T/ha	9.36 T	7.86 T	2.68 T	8.08 T	7.34 T	5.23 T	8.14 T	7.61 T	7 T 2/

Notes: 1/ Disease incidence: index based on 3 assessments after 3, 6 and 9 months for CMD, CBB, CAD, CGM and CMB on a 1-5 scale (1 = healthy plant; 5 = death of plant).

2/ Rounded average: every production figure represents the mathematical average of 4 replications of 2 treatments.