Report No. 474a-UNI

Supplementary Annexes to the Nigerian Oil Palm Projects Appraisal Reports

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CURRENCY EQUIVALENTS

Currency Unit	:	Naira (₦)
US$ 1	=	₦ 0.66
₦ 1	=	US$ 1.52
₦ 1	=	Kobo 100

WEIGHTS AND MEASURES

Unless otherwise stated, all weights and measures used in this report are metric:

1 metric (m) ton	=	0.98 long ton
1 long ton	=	1.016 m ton
1 long ton	=	2,240 lb
1 hectare (ha)	=	2.47 acres (ac)
1 acre (ac)	=	0.405 ha
1 kilometer (km)	=	0.62 mile

ABBREVIATIONS

AA	:	Agricultural Assistant
ADA	:	Agricultural Development Authority (East Central State)
AIC	:	Agricultural Investment Corporation (Western State)
bps	:	bunch purchase slip
CRIN	:	Cocoa Research Institute of Nigeria
EC	:	East Central State (used in tables)
FDA	:	Federal Department of Agriculture
ffa	:	free fatty acid
ffb	:	fresh fruit bunches
FMANR	:	Federal Ministry of Agriculture and Natural Resources
FMG	:	Federal Military Government
IRHO	:	Institut de Recherches pour les Huiles et Oléagineux
LBA	:	Licensed Buying Agent
MEU	:	Monitoring and Evaluation Unit
MW	:	Mid-Western State (used in tables)
NAB	:	Nigerian Agricultural Bank
NIFOR	:	Nigerian Institute for Oil Palm Research
NIJAL	:	Nigerian Joint Agency Ltd.
NISER	:	Nigerian Institute for Social and Economic Research
NPMC	:	Nigerian Produce Marketing Organization
OPC	:	Oil Palm Company Ltd. (Mid-Western State)
PAC	:	Planting Authorization Committee
PAMOL	:	Unilever subsidiary in Nigeria; former owner of Ajagbodudu estate
RRIN	:	Rubber Research Institute of Nigeria
SMU	:	Smallholder Management Unit (Western and East Central States)
TCU	:	Tree Crop Unit (in Mid-Western State)
W	:	Western State (used in tables)
WAIFOR	:	Western Africa Institute for Oil Palm Research (now NIFOR)
WOPC	:	Western Oil Palm Company (Western State)
WSFU	:	Western State Farmers Union

FISCAL YEAR

April 1 - March 31

NIGERIA

OIL PALM PROJECTS

SUPPLEMENTS

Table of Contents

This report contains the common annexes of three appraisal reports of oil palm projects in Nigeria. These three appraisal reports are:

- Western State, Nucleus Estate/Smallholder Oil Palm Project (496a-UNI)
- Mid-Western State, Nucleus Estate/Smallholder Oil Palm Project (497a-UNI)
- East Central State, Smallholder Oil Palm Project (495a-UNI)

Table of Contents (Continued)

Table of contents (Continued)

SUPPLEMENT 1

NIGERIA

OIL PALM PROJECTS

Technical Aspects of Establishment and Production

A. Planting Material and Research

Planting Material

1. A comprehensive breeding and selection programme was laid down at the Nigerian Institute for Oil Palm Research (NIFOR) from 1959 to 1966 and the results of this programme are being appraised in the Institute's Plant Breeding division. In the course of this work the list of palms being used for the production of tenera planting material is being continuously revised.

2. Bunch production is largely determined by environmental factors and is one of the least heritable of the yield components. Though some improvement in the bunch yields may be expected, the main improvements will be in bunch and fruit quality, i.e. in the outturn of palm oil and palm kernels per bunch. NIFOR material is characterized by high fruit to bunch ratios, fairly high mesocarp to fruit, high kernel to fruit, and low to fairly low shell to fruit. Analysis of the material from which the progenies to be distributed would be bred indicates that bunches from adult palms would give mean mill extraction rates of 22% palm oil and 5% kernels (see Supplement 13).

3. Examination of fruit in the field, and particularly in the smallholders' plots of the Palm Grove Rehabilitation Scheme in East Central State, has shown that pollinations done in the early 1960's were satisfactorily executed. Seed production at NIFOR is now being reorganized in a Plant Production division under experienced management and there is no reason to believe that seed produced in the coming years would not be equally satisfactory.

4. Vascular Wilt disease has been widely regarded as the most menacing of all oil palm diseases. In Nigeria it has been almost entirely confined to one large planting, Ajagbodudu Estate, near Sapele, where the 40-year-old stand of palms has been reduced by the disease to 37 per acre (91 per ha). It was also identified on very old palms at Calabar Oil Palm Estate where the incidence was only 1.6%. 1* In 1960 the pathogen was isolated from a few nine-year-old palms at the NIFOR substation, Abak,[2] and from one palm in the dense surrounding groves, but there has been no further development of the disease reported from this area. There have been numerous oil palm plots planted in the main dense wild grove areas of Nigeria since the 1930s and the disease has not been reported from them. Ajagbodudu Estate itself was developed in a forested area where palms were relatively sparse. There is thus no evidence that palms planted in the main dense grove areas

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* Figures apply to the references in Appendix 1.

are at greater risk than those planted in areas where wild palms are sparser. There is evidence from Ajagbodudu Estate, however, that replantings in Wilt-infected estates are likely to show a high incidence of the disease, though this can be reduced by adequate potassium manuring. It has also been shown that an incidence up to 20% has little effect on overall adult yields owing to the positive response of the unaffected adjoining palms.

5. In spite of the low incidence of Vascular Wilt in Nigeria it is obviously prudent to screen all progenies for Wilt tolerance. No progenies are immune to Wilt; some are more tolerant of the presence of the fungus than others. There is some evidence that seedlings tolerant to inoculation with the disease would be tolerant in the field[3,4] though more evidence of this is required. Methods of testing seedlings for tolerance were developed by PAMOL Ltd. and have been used by the Institut de Recherches pour les Huiles et Oléagineux (IRHO) and NIFOR. These methods have certain limitations and a more refined method, capable of assessing tolerance at different levels of inoculum, has recently been developed at Manchester University.[5]

6. In cooperation with PAMOL, NIFOR carried out a programme of progeny Wilt-tolerance testing in the early 1960s but the programme was in abeyance for some years. Results indicated that over 70% of progenies had a good or intermediate tolerance.[6]

7. The plant pathologist at NIFOR has recently been to Manchester University to study the new methods, and the program of progeny testing was restarted during 1973 in cooperation with Ajagbodudu Estate. It is intended to use both methods of tolerance assessment. 102 parents have already been tested in various crosses by the PAMOL method, 200 parents will be tested during 1974 and the remainder should be cleared by 1975. Thereafter new parents would be tested and assessed in various crosses before being brought into use. There is thus no case for importing any planting material on grounds of its Wilt tolerance. Indeed it has been pointed out that the causal fungus produces new forms readily in soil, and that forms from different areas may show marked differences of virulence; selection for tolerance to local strains is therefore important.

8. The quantity of germinated seed required each year is shown in Appendix 5. At peak requirement in 1977 NIFOR would need to produce 3.5 million seeds for the projects. With its present programme of mother palm selection the Institute should have no difficulty in providing this seed.

Other Research

9. Nutritional research at NIFOR would be of particular importance to the projects. Assistance can be given through leaf analysis, soil analysis and fertilizer experiments.

10. A laboratory specially designed for routine leaf and soil analysis has recently been constructed at NIFOR with a capacity of 8-10,000 leaf samples and 1,000 to 1,500 soil samples per annum. If the laboratory staff

at NIFOR can be built up sufficiently to gear the laboratory to its capacity it would be able to deal with all the leaf analysis likely to be required by the projects. It is important for the projects that this should be achieved over the next five years.

11. On the soils side the laboratory can assist in locating with greater precision the areas to include or exclude from planting. The broad soil classification of the IRHO for oil palms[7] is not adapted to detailed use within the Acid Sands soils and the work on soil moisture in relation to soil series initiated at NIFOR[8] may, if pursued, be valuable in determining which smallholders plots are suitable for acceptance in the schemes and the location of future nucleus estates. The estates would provide uniform areas where NIFOR can establish further fertilizer experiments which would provide more refined information on rates and frequencies of fertilizer application.

B. Climate and Soils of the Projects Areas

12. A broad study of the climatic conditions of that part of Southern Nigeria in which the projects lie was recently made by J. Olivin of IRHO, and the following analysis is based largely on data assembled by him. It has been shown that the main influence on the bunch yield of the oil palm in West Africa is the severity of the dry season two years previously[9] and that the general level of yield for any soil class is correlated with measures of water deficit.[7]

Rainfall and Water Deficit

13. The rainfall of Southern Nigeria is shown on map 10562 R attached to this Supplement and it will be noted that all the projects lie in areas having a mean annual rainfall of 2,000 mm (80 in) or more. While this rainfall is usually considered ample for the oil palm, a feature of the rainfall pattern in Southern Nigeria is a marked dry season from November to March, and measurements of water deficit have shown that the latter do not vary directly with the annual rainfall.

14. The water deficits shown in Appendix 2 have been calculated by a standard IRHO formula which assumes a soil water reserve of 200 mm and an evapotranspiration of 150 mm in months with less than 10 days rain and 120 mm in months with 10 rainy days or more. To a large extent the soil classification used with these water deficit estimates (see para 21) is a means of correcting for varying water availabilities. It will be noted from Appendix 2 that water deficits vary considerably from year to year, and this is reflected in the marked variation in annual bunch yields characteristic of planted areas in Nigeria.

15. Map 10561 R attached to this Supplement shows the isodeficit lines estimated from the water deficits of the stations marked. These water deficits related to the period 1950 to 1962 and yield figures from NIFOR and elsewhere

which have been taken into consideration relate to a corresponding period. The Bank's Preparation Mission recommended that in order to obtain satisfactory yields all projects should lie in areas with a water deficit of less than 350 mm. Examination of yield figures available to the mission support this decision, though it must be realized that where soils have a low water supplying capability, water deficits should be considerably below 350 mm for reasonable yields to be obtained. It will be seen from the map that the project area in East Central State lies largely in an area with a mean water deficit between 250 and 300 mm; in Mid-Western State the Mosogar nucleus estates and smallholders areas have deficits between 280 and 300 mm while the Nsukwa estate area has a water deficit of 350 mm with smallholders areas between 290 and 350 mm; in Western State both the nucleus estates and smallholders areas lie in a zone having a mean water deficit of about 320 mm.

Temperature

16. Mean temperatures (see Appendix 3) in the project areas lie between 26°C and 27°C with mean maxima over 30°C and mean minima over 21°C. There is a fall in temperature in the middle of the rains which reduces mean maxima to 27 - 28°C in two months of the year but has little effect on mean minima. There are some cold nights during occasional short periods of harmattan winds in December or January, but in general the prevailing temperatures have no inhibiting effects on the growth of the oil palm and mean temperatures are very close to 28°C which is considered to be the optimum for seedling growth[10].

Sunshine

17. Sunshine records within or near to the project areas are scanty but such as exist indicate that the mean annual sunshine lies between 1,700 and 1,800 hrs (see Appendix 4). Although this is usually regarded as ample, it has been shown that between November and April there is no positive correlation between sunshine hours and total sun and sky radiation, the latter being reduced during the dry season when the atmosphere is dust-filled.[11] It is difficult therefore to set a sunshine-hours criterion for Nigeria conditions; all that can be said is that the overcast conditions in the middle of the rainy season and possibly also the hazy conditions during part of the dry season may have a small adverse effect on production, but that as the major factor affecting yield is the magnitude of the water deficit, sunshine effects, at the satisfactory overall levels which obtain, are likely to be very small.

Soils

18. All the project areas lie on the Acid Sands soils, derived from unconsolidated coarse sandstones interbedded with layers of clay, which cover a very large part of southern Nigeria from west of Okitipupa to Calabar. These are deep, sandy latosols which have been classified into the red Benin fasc and the yellow Calabar fasc soils. Typically, the dominant colour becomes clearer and brighter down the profile and the clay content increases[12].

19. In the Western State and part of the Mid-Western State the Benin fasc soils have been subdivided into soil series (following Vine[13]), but elsewhere soil surveys have not yet attained this detail. The soil series classification is based largely on the quantity of clay plus silt in the 6-18in and 18-30in layers. The better series (e.g. Alagba series) have higher clay contents and are loamy sands overlying sandy clay loams and sandy clays. The poorer, more sandy series (e.g. Ahiara series) are sands or loamy sands to a considerable depth and have a low water supplying power which will accentuate the adverse effect of a prolonged dry season. These latter soils are characteristically found on long or steep slopes towards rivers and so, in the absence of detailed soil series mapping, topography is an important consideration in deciding on the suitability of specific areas.

20. Although usually more leached and containing lower quantities of exchangeable cations, the yellow Calabar fasc soils are not always less suitable than the Benin fasc soils since their deficiencies of potassium and magnesium can be made good by fertilizers; however, within the Calabar fasc region certain excessively sandy soils may be encountered from which only very low yields may be expected.

21. Yield expectations for different soil classes at different levels of water deficit have been estimated by IRHO for West Africa as follows[7]:

Metric tons ffb per ha per annum

Soil

Class	mm 400	350	300	250	200	100	Nil
I	12	13	14	16	18	24	27
IIa	10	11	12.5	14	16	20	25
IIb	8	9.5	11	13	16	20	25
III	6	7.5	9	11	13	16	22

An assessment of adult yield levels on various soils at the NIFOR main station, Ajagbodudu Estate and plots in East Central State has enabled a judgement to be made of the soil classes and yield attainable in the project areas (see Supplement 13).

22. Western State. The nucleus estate area of Iyansan has been soil surveyed and a detailed report prepared by Dr. Ashaye and Mr. Jaiyeola.[14] In all, over 31,000 acres were surveyed and 81% of the area was found to be level or gently undulating land with soils of the Alabga and Okpanam series. Of the remaining 19%, 1% lies on the more sandy Kulfo series and 18% on other Benin series and river alluvium on the slopes and bottoms of small rivers and streams. The Northwest corner of the surveyed area would provide an area

of 4,000 hectares of good soils which can be classed as Class IIa soils or slightly higher. Smallholdings in the surrounding area would be on similar soils.

23. The Iyansan area is in a region of low population; consequently farming is carried out with long fallow periods of around eight years and much of the ground carries a heavy regrowth of secondary forest with only 11% under food crop cultivation in 1972.

24. In contrast to Iyansan the western areas for nucleus estates and smallholder plantings are in a region of higher population with medium to fairly dense palm groves and more frequent food crop cultivation. Nevertheless these areas are also on good Benin fasc soils including areas of Alagba and Okpanam series with occasional patches of the more sandy Kulfo series south of Okitipupa. Though likely to be initially less fertile than the soils at Iyansan, the western soils may be classed as Class IIa, excluding Kulfo, and with correct manuring should yield well. The areas south of Okitipupa are likely to have a mean annual deficit of less than 320 mm.

25. Mid-Western State. At appraisal the soil survey was not yet complete in the Mosogar nucleus estate area and had not started in the Nsukwa nucleus estate area. Comments on the soils are therefore only tentative. Soil survey facilities have only recently been established in the Mid-Western State and a schematic-reconnaissance survey carried out by FAO, though useful as a general guide to Mid-West soils, is not adequate for detailed appraisal.

26. The Mid-West State contains areas of both Benin fasc and Calabar fasc soils and Ajagbodudu estate lies on both fascs. The proposed nucleus estates of Mosogar and Nsukwa lie on Benin fasc, however, and it is recommended that the smallholders plantings south or east of Mosogar estate be confined to Benin fasc soils since the Calabar fasc soils near to the Ethiope river contain some areas of excessively sandy soils.

27. With regard to the soil surveys undertaken in the Mosogar and Nsukwa areas, specific information was requested in a letter to the Chief Agricultural Officer. Subsequent information received confirms basically the tentative conclusions reached during appraisal.

28. The soils of Mosogar have been described by the soil surveyor as clayey sand to 12 inches, with reddish-brown sandy clay below.* This suggests a good Benin fasc soil, but observations made in the field showed that there were a few areas where there was no appreciable increase of clay down the profile to 48 inches. In the FAO map the area lies in the sandier phase of the Benin fasc. There is a good deal of untapped old rubber in the Mosogar area, some farming, and the remainder is heavy regrowth or secondary forest.

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* The terminology is that used by Vine and differs from the terminology used in the FAO survey and in East Central State.

29. The Nsukwa area has an estimated water deficit of 350 mm. The area is flat or gently undulating and on Benin fasc soil. In the FAO map it lies in an area on the border of the sandier and intermediate phases.

30. Though neither of the proposed nucleus estate areas appear to contain any steep or long slopes towards rivers, the adjoining areas for smallholders planting contain such slopes with their concomitant very sandy soils. Experience at NIFOR has demonstrated that such areas are appreciably lower yielding and they should be avoided in selecting smallholders for the project.

31. East-Central State. The area originally selected for the smallholders project comprises that part of the State lying south of the Umuahia-Owerri road and west of a line running south from Umuahia to, and then along, the State boundary. Schematic-reconnaissance surveys were carried out by the Soil Survey Unit of the Ministry of Agriculture before the civil war and a soil map, of about the same detail as that of the FAO map in the Mid-Western State, is available. A Soil Survey Unit has been established at the Federal Agricultural Research and Training Station at Umudike. Some analyses of soils in the area have been done, but no published or collected data are available. However, analyses done by Tinker of oil palm plots in the north, north-centre and south of the area have been published[12].

32. About 80% of the area lies on Benin fasc soils, the remainder, south of a line running east-west about three miles north of Aba, being on Calabar fasc soils. In the extreme south, in Ukwa division, these latter soils contain appreciable areas of deep sands with very low clay content. Analysis of the soil of the NIFOR Akwete plot is probably typical of these areas and as the yield of this plot was never raised above 2 tons ffb per acre even with potassium and magnesium dressings it is considered advisable to exclude from the project all of Ukwa division except its Northwest projection. This would leave only a small area of Calabar fasc soils between three miles north of Aba and the Ngwa-Ukwa border and a smaller area at the south of Oguta division.

33. The Benin fasc soils in the area are typically sandy loams overlying sandy clay loams or sandy clay from 18 inches. Some areas of sandier soils are to be found in the west of the area and on long slopes to the Imo river. The whole area, except for parts of the south of Oguta division, is heavily populated and the soils are degraded by frequent farming in the wild palm groves. Experiments in the area have shown that only very low yields are obtained without manuring, but that if potassium is applied yields of over 10 tons ffb per ha can be obtained even from old unselected palms. There is also evidence that applications of nitrogen would further increase yields. Soils may be considered as Class IIb with some IIa where farming has not been so continuous.

34. In selecting smallholders for the project it is important to exclude any withholdings on slopes towards rivers and on any other areas of excessively sandy soils.

C. Proposed Cultivation Techniques

35. For satisfactory establishment and early bearing under the climatic conditions of Nigeria it is of primary importance to plant large robust nursery seedlings in the field as early as possible in the year, usually April.[15,16] Such plants are well able to weather their first dry season in the field and grow rapidly in their second year and may be brought into bearing when 3 to 3 1/2 years old. A useful demonstration of the importance of early planting is established annually at NIFOR.

36. To obtain suitable plants it is necessary to establish main nurseries 10-12 months before transplanting, i.e. about May. Nursery seedlings planted later would be more liable to Blast disease. Shading is only required if there is an insufficiency of water during the short-dry season (usually August) or during the main dry season. It has been shown that there is a negative correlation between August-September rainfall and Blast incidence and that irrigation during the dry period in these months at least halves Blast casualties.[17,18] For this and other reasons it is necessary to establish adequate irrigation systems for large-scale nurseries.

37. In order to ensure that sufficient culling of abnormal or poorly developed seedlings is done at an early stage it is recommended that nurseries be planted with prenursery seedlings established by planting germinated seed four months previously. The sequence of planting is shown, with appropriate overlaps, in the chart attached to this Supplement.

38. The second most critical factor affecting early and adult yield is correct manuring, and this particularly applies to areas degraded by continuous farming. Experiments have shown[19] that in such areas failure to apply potassium fertilizers would reduce yields by 50%.

39. The third most important factor is the control of vegetation through circle weeding, eradication of harmful weeds in the interrow and control of Pueraria growth.

40. Unless these cultural requirements are fully met, the yields envisaged in the projects will not be attained, and they are therefore dealt with in greater detail below.

Germination

41. It is intended that all planting material should be supplied by NIFOR as germinated seed. This seed would be required during December and

January each year and the germinators would need to be geared to the production of germinated seed in that period. NIFOR possesses a large water-heated germinator and two electrically-operated germinators. The latter are not being operated at present but can easily be brought back into operation during the years of peak requirement. As the supply of germinated seed is required each year within such a short period, NIFOR should be asked to confirm that they would provide the germination space for the projects' planting program (Appendix 5).

Prenurseries

42. Prenurseries are recommended for the projects for the reasons already given. Seedlings have been successfully raised in Nigeria in beds, raised trays and small polybags. For large-scale nursery work the small bag, 6 inches x 8-9 inches lay flat, of 250 gauge polythene and filled with good top soil, has handling advantages.

43. Germinated seed is planted in December-January. The general instructions for planting, protection from disease and manuring in NIFOR Advisory sheets No. 2 and No. 4, which apply equally to bag or bed pre-nurseries, should be closely followed. Shade is not necessary, provided daily watering is carried out, with twice daily watering in periods of harmattan. Culling is likely to be up to 20%.

Main Nurseries

44. The use of polybags has now become general in Nigeria though experience of the operation of large-scale polybag nurseries is limited. Very considerable experience of such operations has been gained in several other countries, e.g. Malaysia, Cameroon and Ivory Coast, and it is on the basis of both this and Nigerian experience that the following recommendations are made.

45. Large polybags of 500 gauge black polythene, 16 inches x 20 inches lay flat with drainage holes perforated on the lower half of the bag, have been found suitable[20]. As watering is all-important both for satisfactory growth and for Blast disease control all nursery sites should be provided with sprinkler irrigation systems capable of supplying about 1/3 inches water per day[21]. These systems must be operable at all times.

46. Polybags should be spaced at 3 ft triangular from the start. It is possible to reduce early water consumption by closer spacing during the first 4-5 months, but proper spacing from the time of establishing the nursery has certain advantages, viz. (1) the work of moving the bags to wider spacing is eliminated, (2) all plants can be individually inspected without difficulty, (3) closer spacing causes etiolation and reduced growth in terms of weight per plant,[21] and (4) spraying against Cercospora Leaf Spot can be thoroughly carried out. Irrigated nursery designs give approximately 120,000 plants per 10 ha (25 acres) of nursery, sufficient for about 650 ha (1,600 acres) of field planting.[22]

47. Standard NIFOR recommendations (Advisory Sheet No. 5) should be followed for nursery manuring, i.e. 0.5 oz per plant in May, 1.5 oz in July and 2 oz in October and in January/February of a mixture of 1 part sulphate of ammonia, 1 part superphosphate (18% P_2O_5), 1 part muriate of potash and 2 parts magnesium sulphate.

48. At the time of transplanting a rigorous culling standard should be adopted; all abnormal plants, i.e. those which are unusually erect or squat, with leaflets fused, narrow, short, abnormally close together or wide apart or inserted at an acute angle, should be eliminated. Losses of up to 20% have been allowed for, and seed and seedling supply has been estimated for the projects as follows:

(1) 100 germinated seeds to give a minimum of

(2) 75 transplanted prenursery seedlings and

(3) 64 transplanted nursery seedlings per acre (including an allowance for supplying).

Land Preparation

(1) Nucleus Estates

49. The vegetative cover of the nucleus estate areas varies considerably. Some areas are in secondary forest, old rubber or strong old fallow regrowth, while other areas have recently been cultivated and carry only light regrowth. The number of grove palms varies from 0 to about 150 per ha. Costs of establishment have been estimated separately for secondary forest, rubber or strong regrowth and for farms, fallows and palms; project costs for field establishment have been derived using a weighted average factor (see costing tables in appraisal reports).

50. It is recommended that when the area for the estate has been surveyed and demarcated the roads for the planting area be cleared and constructed first in order to facilitate establishment operations. Underbrushing and felling by axe and chain saw should be complete by early December to allow for drying out so that a good burn is obtained early in the year; all other preparatory operations should be completed by the end of March or early April. Pueraria should be sown at the rate of 6.5 kg per ha after the rains have set in and following seed treatment with sulphuric acid or by the water-soaking and heat treatment method recently developed at NIFOR.[23] Planting too far in advance of the rain or in high concentrations of ash leads to poor establishment or even failure.[24]

51. The recent infestation of many areas in Nigeria, and particularly those which have been under food crop cultivation, with Eupatorium odoratum has presented a serious weed problem. This plant, which grows exceedingly rapidly and competes with young palms for water, nutrients and light, must be eradicated and kept out of all plantings.[25] It has been shown that the

weed can be killed by 2,4-D or 2,4,5-T, but eradication must be followed by Pueraria establishment and regular patrolling to prevent reinfestation.[26] Recently, eradication by spraying with a solution of 1.5 oz Trioxone (2,4,5-T) to 1 gallon of water has been successfully carried out on a field scale on an estate in Western State on heavily infested fallows before clearing operations started. This costed only ₦ 7.50 per ha and assisted the clearing operations.

(2) Smallholdings

52. Consideration has been given to allow smallholders in the projects to intercrop with food crops and to retain up to 20 grove palms per acre until year 4. For the following reasons neither practice is recommended.

53. Although experiments have shown that, on forest soils and if very carefully controlled, food cropping can be practiced for a limited period without reducing yields, on already cultivated or poorer soils yields can be affected.[27] Smallholders tend to plant food crops far too near the young palms and under these circumstances they compete for water, nutrients and sometimes for light. Moreover, with such planting, the smallholder frequently lops off functional green leaves of the growing palms, thus checking their development and reducing their early yield.

54. Experiments on leaving in old palms, whether in groves or planted areas, have given conflicting results;[28] though sometimes higher bunch yield have been obtained over periods of 8 to 12 years when a proportion of the old stand has been retained for a few years, the growth and yield of the young palms have always been retarded by this practice. Moreover the much higher oil content of the fruit from the young palms makes it desirable to bring these into bearing and to their adult yield in the shortest possible time.

55. However, there are practical considerations which also lead to the recommendation to clear all old wild grove palms before planting. It is often difficult to persuade smallholders to fell bearing old palms when the young palms begin to fruit, and, when eventually felled, these palms may damage the young stand. Moreover proper preparation of the land for planting, and particularly the establishment of a good leguminous cover, is impeded by the presence of old palms.

56. Though some smallholders' plantings would be in areas of secondary forest, the majority would be in areas of palm groves, fallows and cultivation. The main problem in these cases would be the eradication of Eupatorium and its replacement with a good planted cover of Pueraria.

57. It has been agreed that areas with more than 30% Eupatorium cover would not be acceptable for planting palms. However, there is no reason why farmers should not bring such areas into a condition where they would become acceptable, and it is suggested that this could most easily and profitably be done by digging out the Eupatorium and preventing reestablishment through food-cropping for a full season with early maize followed by yams

or cassava. A Pueraria cover could be sown after the crops had been harvested; however, such work would be undertaken by the farmer on his own and would not form part of work done under the projects.

58. Applicants with areas having less than 30% Eupatorium would be required to eradicate the weed by digging before qualifying for a clearing grant. The manday allowance for underbrushing and clearing on smallholders' lots includes provision for Eupatorium eradication. The Agricultural Assistants in charge of groups of smallholders would need to be particularly vigilant not only in seeing that the weed is eradicated during land preparation but also in persuading smallholders to prevent reinfestation by regular patrolling and pulling up of stray plants.

59. In order to ensure a good Pueraria cover on smallholdings a higher seed rate is recommended than for estates, viz 11 kg per ha has been budgeted for instead of 6.5 kg per ha, so that a second sowing can be carried out if necessary.

Planting in the Field

60. As mentioned in paragraph 35, early planting is essential. If there has already been appreciable rain, planting can start in late March, and with large programs to complete it should never start later than mid-April. Even well-transplanted field-nursery plants are able to withstand two rainless weeks; polybag plants are better able to do so and grow all the faster through being already firmly planted when the rains set in.

61. Polybag plants must be previously watered in the nursery and when planting a good contact with the surrounding soil must be established through consolidation and ensuring that earth is well packed into the gaps between the sides of the hole and the ball of soil around the plant's roots. Deep planting must be particularly avoided; the base of the seedling should be just above the level of the ground. A collar of 1/2 inch wire netting, 18 inches high with a circumference of 30 inches, must be carefully fixed around the seedling and pegged down on the day of planting as a protection against rodents. Failure to do this has often led to loss of large parts of a new planting. These collars must be retained around the plants for around 18-24 months.

Castration

62. The removal of inflorescences by hand or, very carefully, with a narrow-bladed chisel may be done on the nucleus estates from about 18 months from planting until six months before the palms are to be brought into bearing. This will enhance vegetative growth and increase initial bunch yields.

Field Maintenance

63. With young palms circle weeding should be undertaken to an inital radius of 3 ft and thereafter, as the palm grows, to one foot beyond the tips of the leaves. While the palms are still young it is of particular importance to prevent the Pueraria cover from climbing over the lower leaves which touch the ground. When the palm has developed a trunk and the leaves are well off the ground a circle of 5-6 ft radius should be maintained. Circle-weeding is at an initial rate of ten times a year and this is gradually reduced to four times by year 5. Slashing rounds are necessary for the control of the interrow cover; these must also be frequent in the early years but can be reduced to twice a year when the palms are fully developed.

64. Eupatorium must be kept out of the estates and smallholdings by regular patrolling. A continuous patrol of 5-10 men has been found very effective over the 1,000 hectares of the NIFOR Main Station which lies in an area infested by the weed. It was noticed that on some other estates in Nigeria control methods used have not succeeded in keeping out the weed altogether. However, on one young planting where a system of contracting out the maintenance work has been adopted, control is very satisfactory. Each contractor is responsible for 16 ha (40 acres) and in the initial stages is required to ring-weed and slash every month.* Such a system could be adapted to the age of the plantings with contractors gradually taking on larger areas as the frequency of ring-weeding and slashing is reduced. Contractors could be responsible for patrolling their areas for Eupatorium or the estate could have a small centrally-organized patrol.

Manuring

65. The rates of application recommended for the different project areas are shown below. In young plantings the fertilizers should be broadcast over the whole surface of the weeded circle. With older palms, from about 4 years, fertilizer should be spread in a broad band between the edge of the weeding circle and the extremities of the leaves. With adult palms where the leaves have reached their full length, fertilizer may be broadcast over the whole width of the interrow. Annual applications should be made at the beginning of the rains in April or May, but not when the rains have fully set in.

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* Contractors have been paid ₦ 60 per month; if they employ 1 assistant and work 25 days they will each earn ₦ 1.20/manday, and the slashing plus ring-weeding will be carried out at the rate of 3.1 mandays/ha/month.

Kg of fertilizer per ha per annum

Year	Western and Mid-Western States			East Central State		
	Sulphate of Ammonia /4	Muriate of Potash	Magnesium Sulphate	Sulphate of Ammonia /4	Muriate of Potash	Magnesium Sulphate
0 /1	33 (0.5) /2	33 (0.5)	13 (0.2)	33 (0.5)	33 (0.5)	13 (0.2)
1	65 (1.0)	65 (1.0)	33 (0.5)	65 (1.0)	65 (1.0)	33 (0.5)
2	100 (1.5)	130 (2.0)	65 (1.0) /3	100 (1.5)	130 (2.0)	
3	130 (2.0)	200 (3.0)	65 (1.0) /3	130 (2.0)	200 (3.0)	
4		200 (3.0)	65 (1.0) /3	130 (2.0)	200 (3.0)	
5		200 (3.0)	100 (1.5) /3	130 (2.0)	200 (3.0)	
6 /5		**200 (3.0)**	**100 (1.5) /3**		**200 (3.0)**	

/1 Year 0 = planting year.
/2 Figures in brackets are applications in lbs per palm; rates per hectare are based on the assumption that the triangular planting distance will be 29 ft (8.8m).
/3 Dressings of magnesium sulphate would need to be continued on Calabar fasc soils at Ajagbodudu Estate. Such dressings would also be needed for smallholders on these soils in Mid-Western and East Central States, but the proportion of holdings on these soils is expected to be small.
/4 Sulphate of ammonia is recommended for the full non-bearing period for all areas and for continuance for two bearing years in East Central State.
/5 And onwards.

Supplying

66. Supplying at points where, through pest attacks or other reasons, plants have not established themselves satisfactorily may be done up to the end of June in the planting year. Apart from this, supplying is only worthwhile in year 1, when it should amount to not more than 1% of the stand.

Harvesting and Pruning

67. Harvesting in the early years should be carried out using chisels with blades 65 to 75mm wide in accordance with instructions in NIFOR Advisory Sheet No. 15. Chisel harvesting should be carried on as long as possible, as with this method no green leaves need be cut. Later, harvesting should be by the pole-knife method. If necessary a short-handled axe may be used before the pole-knife method is brought into operation, but a cutlass should not be used as this implement tends to cause wounding with consequent

Rhynchophorus weevil attack. Similarly, pruning leaves too near to the trunk of the palm may cause wounds which will give access to weevils.

68. Over-pruning, as well as under-pruning, is often seen in Nigeria both on estates and smallholdings. Pruning should follow NIFOR Advisory Sheet No. 14, i.e. pruning of young palms should be confined to leaves badly infected with Cercospora, while areas in bearing should have one pruning round per year, usually in the dry season, in which all dead leaves should be cut off and creepers and ferns removed from the crown. No green leaves should be cut.

Disease Control

69. Cercospora Leaf Spot. This disease is usually carried over from the nursery into the field and may persist for 2-3 years. As well as the pruning mentioned above, the plants should be sprayed with Dithane 45 according to the instructions in NIFOR Advisory Sheet No. 2.

70. Ganoderma Trunk Rot. In Nigeria Ganoderma is present in all grove areas and is a disease of senescence. In planted areas the disease is not often encountered until palms reach about 40 years of age, and comparatively few cases have been encountered in planted palms at all. The fear has been expressed that with more general planting and replanting the disease might become more aggressive at a younger age as has occured in Malaysia. NIFOR experience is that on the Abak Substation in a grove area in South-East State there have not yet been any cases with palms up to the age of 24 years, except for some seedlings planted near to infected old palms, but at the Main Station near Benin there were a few cases in a 25-year-old planting and five cases have been reported in a 14-year-old replanted area. It is not considered that the disease is yet sufficiently dangerous to palms in their normal productive span to justify the great expense of digging out and disposing of all the old palms, whether in groves or estates. However, where individual old palms are found to be infected with the fungus they should be destumped, cut up and destroyed by burning.[29]

71. Dry Basal Rot. Outbreaks of Dry Basal Rot, caused by Ceratocystis paradoxa, have occured from time to time on estates in the Mid-West, and there have been minor outbreaks at NIFOR Main Station in recent years. Though its effects can be locally devastating, there is usually a high recovery rate when palms pass the susceptible stage. Typically the disease has attacked palms that have recently come into bearing and which are growing on sandy soils or in areas of high water deficit. There have been distinct progeny differences of susceptibility. It is not thought that the disease is likely to be of importance in the areas chosen for the projects, but NIFOR is engaged in testing progenies for tolerance to the disease.

NIGERIA

OIL PALM PROJECTS

References

1. PRENDERGAST, A. G. (1957). Observations on the epidemiology of Vascular Wilt disease of the oil palm. J.W. Afric. Inst. Oil Palm Res., 2, 148.

2. WAIFOR Ninth Annual Report. 1960-61, page 80.

3. PRENDERGAST, A. G. (1963). A method of testing oil palm progenies at the nursery stage for resistance to Vascular Wilt. J. W. Afric.Inst. Oil Palm Res., 4, 156.

4. RENARD, J. L., GASCON, J. P. and BACHY, A. (1972). Research on Vascular Wilt of the oil palm. Oléagineux, 27, 581.

5. LOCKE, T. (1972). A study of Vascular Wilt disease of oil palm seedlings. Ph. D. Thesis, Manchester University.

6. WAIFOR Tenth and Eleventh Annual Reports (1961-62, 1962-63) pages 83 and 81 respectively.

7. OLIVIN, J. (1968). Etude pour la localisation d'un bloc industriel de palmiers à huile. I. Les critères de jugement. Oléagineux, 23, 499.

8. ATAGA, D. O. (1973). Determining moisture content of some soils supporting oil palms (Elaeis guineesis, Jacq.) by the neutron moderation method. J. Nig.Inst.Oil Palm Res., 5, (18), 13.

9. SPARNAAIJ, L. D., REES, A. R. and CHAPAS, L. C. (1963). Annual yield variation in the oil palm. J. W. Afric.Inst.Oil Palm Res., 4, 111.

10. HENRY, P. (1957) Quoted by Michaux, P. Oléagineux, 16, 523.

11. HARTLEY, C. W. S. (1967). The Oil Palm. Longmans, London, page 108.

12. TINKER, P. B. H. and ZIBOH, C. O. (1959). A study of some typical soils supporting oil palms in Southern Nigeria. J. W. Afric.Inst. Oil Palm Res., 3, 7.

13. VINE, H. (1956). Studies of soil profiles at the WAIFOR main station and at some other sites of oil palm experiments. J. W. Afric.Inst.Oil Palm Res., 1(4), 8.

14. ASHAYE, T. I. and JAIYEOLA, K. E. (1972). Soils and land-use studies in Iyansan N. W. area, Okitipupa Division, in connection with sugarcane cultivation. Inst. Agric. Res. and Training, Ibadan. (Mimeograph).

15. TOOVEY, F. W. (1953) Field planting of oil palms. J. W. Afric.Inst. Oil Palm Res., 1, (1), 68.

16. SPARNAAIJ, L. D. (1959). The development of transplanting techniques for the oil palm in West Africa. J.W. Afric. Inst. Oil Palm Res., 2, 281.

17. ROBERTSON, J. S., PRENDERGAST, A.G. and SLY, J.M.A. (1968). Diseases and disorders of the oil palm in West Africa. J.W. Afric. Inst. Oil Palm Res., 4, 389

18. WAIFOR Eighth and Ninth Annual Reports (1959-60, 1960-61), pages 109 and 78-79 respectively.

19. WAIFOR Twelfth Annual Report (1963-64), page 30.

20. NIFOR Fourth and Sixth Annual Reports (1967-68, 1969-70), pages 25-27 and 21-22 respectively.

21. BEVAN, J.W.L. and GRAY, B.S. (1969). The organization and control of field practice for large-scale oil palm plantings in Malaysia. Inc. Soc. of Planters, Kuala Lumpur.

22. GUNN, J.S. SLY, J.M.A. and CHAPAS, L.C. (1961). The development of improved nursery practices for the oil palm in West Africa. J.W. Africa. Inst. Oil Palm Res., 3, 209-10.

23. AYA, F.O. (1973) Germination inhibitors in the seeds of Pueraria phaseoloides. J.W. Afric. Inst. Oil Palm Res., 5, (18), 7.

24. WAIFOR Eleventh Annual Report (1962-63), page 52-3.

25. EDITORIAL (1968). J.W. Afric. Inst. Oil Palm Res., 5, page 2.

26. SHELDRICK, R.D. (1968). The control of Siam Weed (Eupatorium odoratum). J.W. Afric. Inst. Oil Palm Res., 5, 7.

27. SPARNAAIJ, L.D. (1957). Mixed cropping in oil palm cultivation. J.W. Afric. Inst. Oil Palm Res., 2, 244.

28. HARTLEY, C.W.S. (1967). The Oil Palm. Longmans, London. Pages 443-46.

29. TURNER, P.D. and BULL, R.A. (1967). Diseases and disorders of the oil palm in Malaysia. Inc. Soc. of Planters, Kuala, Lumpur. Page 116.

NIGERIA

OIL PALM PROJECTS

Annual Water Deficit (Inches)

Stations	Rainfall No. of Years	Rainfall Mean	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	Mean Annual Water Deficit Inches	mm
Western State																	
Ondo	52	62.1	16.0	13.0	11.2	14.4	11.0	13.1	13.4	10.8	11.7	9.6	11.3	17.2	11.2	12.6	320
Okitipupa	23	93.9		14.5	11.2	14.6	14.2	7.1	11.2	10.6	11.5	14.9	15.5	14.6	12.3	12.7	320
Ilititun	10	77.6			11.7	16.2	15.5	8.2								12.9	325
Abigi	10	104.3			12.6	17.2	10.1	5.2	10.2	15.3	12.8	11.0	12.2	12.7		11.9	300
Mid-West State																	
NIFOR	21	73.3	16.4	15.3	15.6	10.9	8.8	15.4	11.6	8.4	15.6	12.2	15.2	15.9	10.8	13.2	335
Benin City	55	79.2	17.3	12.4	16.3	10.0	6.6	13.4	10.6	6.6	13.0	13.1	16.2	14.6	11.7	12.4	315
Ubiaja	20	73.5	14.0			14.9	9.4	13.3	20.8			16.2	11.6	13.5	15.0	14.3	365
Agbor	46	74.7	11.0	14.4	15.3	13.9	10.4	12.4	7.9	15.2	24.7	14.9	15.4	14.7	16.6	14.4	365
Asaba	30	64.6					11.7	20.4	24.4	10.9	20.5	16.6	17.1			17.4	440
Koko	11	91.1	17.8			9.1	6.8	11.8	9.0	12.8						11.2	285
Sapele	55	94.1	16.2	11.9	13.4	11.4	11.5	13.1	10.7	15.4	11.5	12.0	18.4	12.6	11.8	13.1	330
Cowan Estate	15	90.6	14.6	12.0	13.4	8.5	11.4	14.3	8.1	12.9	7.8	6.8	13.9	8.9	10.0	11.0	280
Onitsha	12	84.0					9.7	12.4	12.4	9.5	13.2		14.1	10.6	9.8	11.5	290
Abraka	9	99.3			13.7	12.5	11.4	12.9	10.8	11.1	4.8			9.8		10.9	280
Obiaruku	24	89.5		14.5	14.9	10.7	10.3	11.2	9.6	11.8	9.9	9.5	12.7	9.7	12.6	11.5	290
Kwale	2	88.8	16.6	15.8	16.1	6.6	12.3	15.6	8.2	10.2	7.4	9.8	15.8	18.7	13.8	12.8	325
Warri	54	109.1	10.9	7.3	7.5	5.8	6.1	8.0	17.7	6.2	6.8	7.7	7.1	3.3	9.2	7.2	185
Ughelli	10	101.6	8.0	7.7	7.3	8.5	5.5	10.3	0				5.1	14.1		7.4	190
East Central State																	
Onitsha	16	72.3					12.9	16.3	14.3	15.4	18.5	15.6	13.9	20.9	12.4	15.6	395
Awka	19	73.8	14.7	17.9	16.2	18.9	7.8	16.3	12.3	13.9	12.6	15.1	16.3	23.2	10,9	15.1	385
Afikpo	51	78.5	20.5	12.6	16.8	20.2	9.7	14.5	13.2	12.1	18.6	16.3	18.8	18.5	10.2	15.5	395
Enugu	43	70.6	15.3	19.8	15.4			17.8	11.3	14.1	16.8	16.5	16.7	21.6	12.4	16.2	410
Oguta	10	91.7			13.0	13.5	9.3	14.4	9.8	9.6			16.2	15.7	10.1	12.4	315
Okigwi	21	76.1	8.6	15.3	18.0	11.9	10.8	12.4	12.0	12.1	14.3	18.5	19.6			13.9	355
Owerri	53	96.0	11.9	14.9	10.0	11.9	5.8	10.9	10.1	11.9	12.6	12.6	8.0	15.0	10.0	11.2	285
Umuahia	14	83.7	17.1	11.7	14.2	10.5	6.6	11.0	10.4	10.5	9.0	12.9	16.6	16.6	11.3	12.2	310
Aba	28	89.1	11.9	13.8	16.1	8.8	6.4	6.9	9.5	11.9	10.5	3.6	11.3	10.4	8.2	9.9	250

Complementary Data (Inches)

Stations	Rainfall No. of Years	Rainfall Mean	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	Mean Annual Water Deficit Inches	mm
Igueben Estate	10	69.2								14.8	14.9	18.7	26.6	14.3	18.2	18.2	19.2	19.4	18.3	465
Ewohimi Estate	10	67.5								19.7	16.6	20.8	23.8	13.0	7.9	17.8	16.1	18.8	17.2	435
Ubuluku Estate	10	75.0												16.7	13.6	19.2	19.0	18.5	17.4	440

NIGERIA

OIL PALM PROJECTS

Average and Minimum Monthly Temperatures
(Centigrades)

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year	State
Ondo	Av.	26.5	27.6	27.4	26.7	26.1	25.2	24.1	23.7	24.5	25.2	26.3	26.3	25.8	Western
1951/65	Min.	21.6	22.3	22.5	22.2	21.9	21.4	21.1	20.7	21.2	21.2	22.0	21.6	21.7	State
Benin City	Av.	26.7	27.7	27.7	27.5	27.1	25.9	24.7	24.4	25.3	26.1	26.9	26.6	26.4	Mid-Western
1951/65	Min.	21.4	22.1	22.6	22.6	22.6	21.9	21.6	21.2	21.8	21.8	22.1	21.2	21.9	State
NIFOR	Av.	26.4	27.6	27.6	26.9	26.5	25.6	24.5	24.4	25.1	25.7	26.6	26.4	26.1	Mid-Western
1952/66	Min.	21.7	22.4	22.5	22.3	22.1	21.7	21.6	21.4	21.7	21.6	22.0	21.4	21.9	State
Warri	Av.	26.9	27.8	28.1	28.0	27.6	26.3	25.4	25.3	25.7	26.5	27.7	27.1	26.8	Mid-Western
1951/65	Min.	21.9	22.8	23.3	23.4	23.1	22.6	22.3	22.1	22.4	22.4	23.2	21.9	22.6	State
Umudike	Av.	26.2	27.3	27.2	27.5	26.4	26.0	25.4	25.4	25.7	25.9	27.0	26.4	26.4	East Central
1923/62	Min.	20.5	21.1	22.1	23.0	22.5	22.3	21.8	21.9	21.9	21.5	22.3	21.5	21.9	State

Note: Av. = Average temperature.
Min. = Minimum temperature.

NIGERIA

OIL PALM PROJECTS

TOTAL ANNUAL SUNSHINE, IN HOURS

	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	Annual Mean
Lagos (Ikeja)	1,971	1,789	1,935	1,862	1,789	1,935	1,862	1,862	1,898	2,008								1,891
Benin City						1,935	1,789	1,862	1,935	1,752								1,855
NIFOR		1,223	1,679	1,493	1,597	1,478	1,990	1,907	2,056	2,047	1,992	1,871	2,005	1,790	1,900	1,980	1,852	1,792
Enugu	2,227	2,044	-	-	2,081	2,081	2,154	2,081	2,227	2,227								2,140
Port Harcourt						1,497	1,570	1,497	1,606	1,497								1,533
Umudike Research Station	.	.	.	.	.	.	.	.	.									1,777

Maximum	1956/64	2,121
Mean	1956/64	1,777
Minimum		1,398

- Lagos: Lagos State.
- Benin City and NIFOR: Mid-West State.
- Enugu: East Central State.
- Port Harcourt: Rivers State.
- Umudike Research Station: East Central State.

Supplement 1
Appendix 5

NIGERIA

OIL PALM PROJECTS

Seed Requirements /1 (thousands)

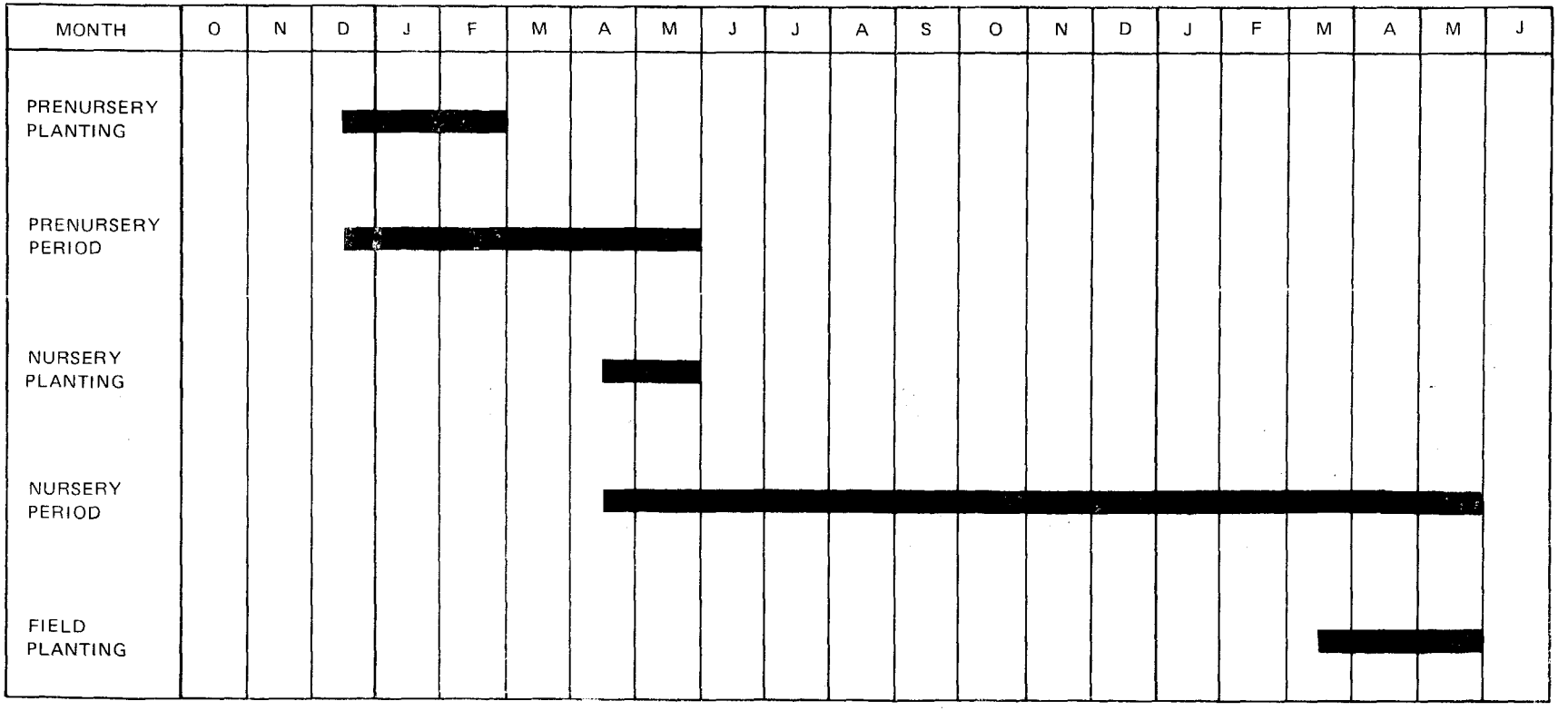
	1974/75 /2	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81
Western State							
Estates	200	275	325	400	300	-	-
Smallholdings	100	150	200	400	150	-	-
	300	425	525	800	450	-	-
Mid-Western State							
Estates	200	300	400	500	160	200	200
Smallholdings	200	300	400	500	600	-	-
	400	600	800	1,000	760	200	200
East Central State							
Smallholdings	500	750	750	1,000	1,000	-	-
TOTAL GERMINATED SEEDS	1,200	1,775	2,075	2,800	2,210	200	200
NIFOR SEED PRODUCTION /3	1,500	2,220	2,595	3,500	2,765	250	250

/1 Germinated seed at 250 per ha (100 per ac of 60 palms).

/2 Germinated seed for the 1976 plantings must arrive during December and January 1974/75 and so on.

/3 NIFOR seed production assuming 80 percent germination.

NIGERIA
OIL PALM PROJECTS
SEQUENCE OF PLANTINGS



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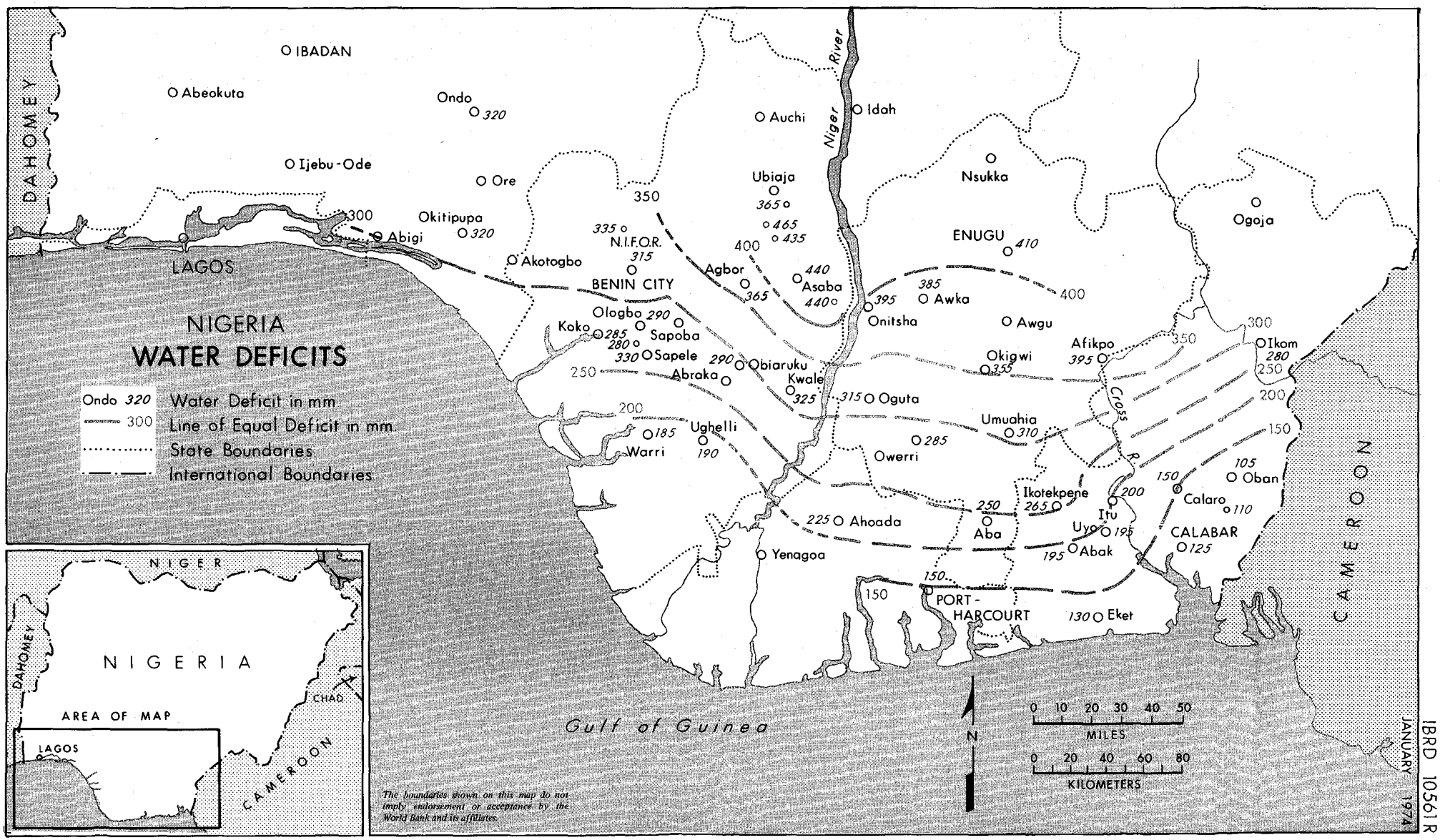
NIGERIA
WATER DEFICITS
Ondo 320 Water Deficit in mm
300 Line of Equal Deficit in mm
State Boundaries
International Boundaries
DAHOMEY
CAMEROON
Gulf of Guinea
Niger River
Cross R.
IBADAN
Abeokuta
Ondo 320
Ijebu-Ode
Ore
Okitipupa 320
Abigi
LAGOS
Akotogbo
N.I.F.O.R. 315
BENIN CITY
Auchi
Idah
Ubiaja 365
Agbor 365
Asaba 440
Onitsha 395
Awka 385
Awgu
Nsukka
ENUGU 410
Ogoja
Ologbo 290
Koko 285
Sapoba 280
Sapele 330
Abraka
Obiaruku 290
Kwale 325
Oguta 315
Okigwi 355
Afikpo 395
Ikom 280
Umuahia 310
Owerri 285
Ughelli 190
Warri 185
Ahoada 225
Yenagoa
Ikotekpene 265
Aba 250
Itu 200
Uyo 195
Abak 195
Oban 105
Calaro 110
CALABAR 125
PORT-HARCOURT
Eket 130
300
350
400
250
200
150
N
0 10 20 30 40 50
MILES
0 20 40 60 80
KILOMETERS
NIGER
CHAD
AREA OF MAP
LAGOS
CAMEROON
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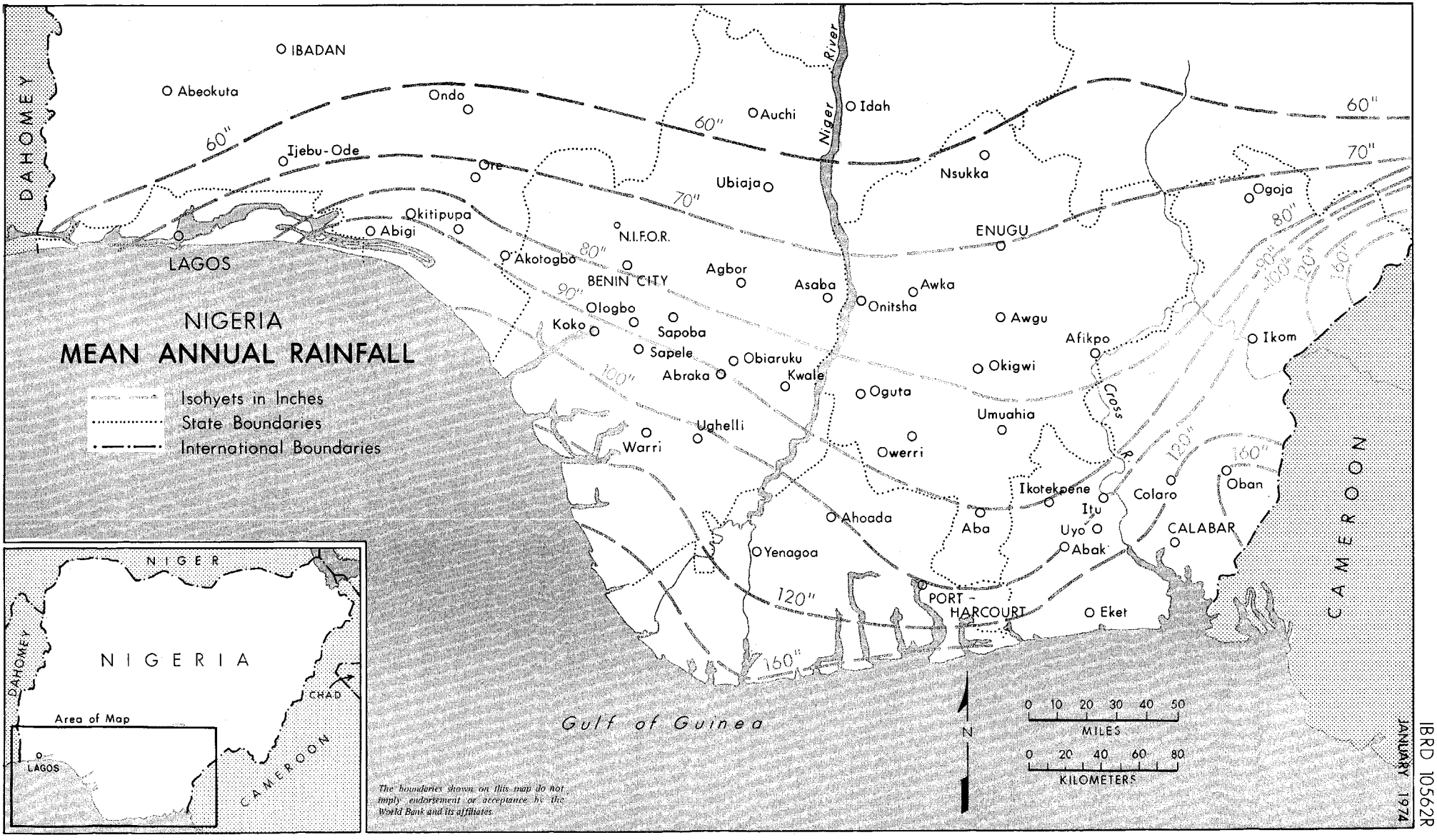
IBRD 10561R
JANUARY 1974


NIGERIA
MEAN ANNUAL RAINFALL
Isohyets in Inches
State Boundaries
International Boundaries
DAHOMEY
IBADAN
Abeokuta
Ondo
Ijebu-Ode
Ore
Okitipupa
Abigi
LAGOS
Akotogbo
N.I.F.O.R.
BENIN CITY
Ologbo
Koko
Sapoba
Sapele
Obiaruku
Abraka
Kwale
Agbor
Asaba
Auchi
Idah
Niger River
Onitsha
Awka
Awgu
Afikpo
Ikom
Okigwi
Oguta
Umuahia
Owerri
Warri
Ughelli
Ubiaja
Nsukka
ENUGU
Ogoja
Cross R.
Ikotekpene
Itu
Uyo
Abak
Colaro
Oban
CALABAR
Aba
Ahoada
Yenagoa
PORT - HARCOURT
Eket
CAMEROON
Gulf of Guinea
60"
70"
80"
90"
100"
120"
160"
0 10 20 30 40 50
MILES
0 20 40 60 80
KILOMETERS
N
NIGER
NIGERIA
CHAD
CAMEROON
DAHOMEY
Area of Map
LAGOS
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NIGERIA

OIL PALM PROJECTS

Farming Systems in the Project Area

A. Land Tenure

1. The system of land tenure is not uniform, but generally land ownership is vested in the various communities with any grants or transactions being under the direct control of the head of the community in consultation with the elders. Land is allocated by the community to its constituent families, or, sometimes, to individuals on a more or less permanent basis, according to their needs and capabilities. Fragmentation of holdings does not yet appear to be a serious problem. 1/ Granting of land by a community to one of its native families confers virtually permanent right of occupation, so long as it is used, but normally with restrictions on rights of disposal, particularly to non-natives; land is traditionally granted to outsiders only for the growing of annual crops, but in practice this rule is not invariably enforced. With increasing pressure from population 2/ there is a growing market in land, which despite traditional constraints is frequently purchased, pledged and leased and a growing tendency towards individual ownership is apparent. Nevertheless, even within the traditional system, the rights of the planter of a permanent crop to maintain and harvest it are usually well recognized. In the more densely settled areas near the towns, where land may have been occupied by a family for several generations, the family is increasingly accepted as possessing virtually, 'freehold' title. Although title is generally unrecorded, family and individual rights are usually well known and accepted within the community. In general, therefore, the land tenure system provides adequate security of tenure for the planting of tree crops. Tenancy on land belonging to absentee owners of an individual or family inheritance is fairly common, with the tenant paying either an agreed rent in cash or kind or a share of the crop. Although some of these absentee landowners would probably be interested in planting oil palm under the scheme, it is proposed for reasons both of equity and ease of supervision to restrict participation in project grant/credit to genuine operating farmers.

1/ In the Mid-Western State according to a Government survey of 1969, in Western Urhobo Districts, 67% of holdings had all their annual crops concentrated in one parcel; similarly for the state, 55% of rubber and 79% of cocoa holdings were in a single parcel.

2/ This is especially true in East Central State, and partly also in the Mid-Western State. It is not yet so apparent in the Western State.

B. Cropping Patterns

Western State

2. No detailed studies are available of existing cropping patterns specifically in the project area; however some indication of cropping patterns in the southern rain forest zone of the Western State is given in a recent survey report. 1/ A table showing land allocation to different enterprises on various types and size of farm is given in the table on page 3.

3. With an average cultivated area in each family holding of only one hectare, 2/ the vast majority of farms are fully engaged in the production of food crops, mainly maize, yam and cassava. On small arable farms (2 ha and under) over half the cultivated area is usually under cassava, with up to a third planted to maize (often interplanted with cassava) and most of the rest under yam. Yam or cassava intercropped with maize is generally the first crop planted on freshly prepared land. In the second year crop mixtures such as maize/cassava, cassava/melon, maize/melon, or yam/maize are commonly found. The third year crop, if grown, is predominantly cassava.

4. On a larger farm, however, after harvesting arable crops, land may then be planted with a tree crop such as cocoa, kola or oil palm. Owing to the investment of cash and land required for planting tree crops, it tends to be the larger farmers or absentee landowners who are most interested in establishing or expanding a plantation of oil palm.

5. So far only a relatively small proportion of farmers in the oil palm belt of the Western State have planted oil palm. A survey carried out by the State Ministry of Agriculture and Natural Resources in 1972 estimated that some 35,000 farmers had planted, 3/ of which 21,000 were in Ibadan Province and 9,000 in Ondo Province (in which the project area is situated). The average size of plantation was small, only 0.6 ha, 4/ and in every case was shown as mixed stand, i.e. interplanted with food crops or another tree crop. However, a surprisingly large percentage of the total area devoted to oil palm was found on small farms with a total size in the range of 0.2 to 1.0 hectare. But in the project area very few of such plantings were observed on smaller farms during appraisal.

1/ Farm Income and Resource Management in the Western State of Nigeria, Ministry of Agriculture and Natural Resources, Ibadan, June 1972.

2/ Rural Economic Survey of Nigeria.

3/ Out of an estimated total of some 910,000 farmers in the State.

4/ About the same as for cocoa and kola.

6. It should be possible for some farmers, at least those farming on communally-owned land, to extend their acreage to allow them to plant; others may be prepared to reduce their acreage under arable crops, or else, more likely, to shorten their fallow periods. While there is bound to be some degree of displacement of food crop production in the area by the project, in view of the relatively small percentage of total useable land to be planted by smallholders, and the relatively long fallow periods, it is not thought that this will be serious. Additionally, the demonstrated benefits of fertilizing and weeding young oil palms may well encourage the development of these practices on food crops as well. In the long run it will be necessary for farmers to increase their food crop yields in any case.

Percent of Net Cropped Land Allocated to Enterprises by Classes of Farming Units in the Southern Rain Forest Zone

Enterprise	Large	Medium (Mixed)	Medium (Arable)	Small (Mixed)	Small (Arable)
Maize	20.2	9.5	36.9	-	10.4
Yam	11.9	21.6	7.3	4.1	8.8
Cassava	18.6	9.5	33.8	4.1	53.0
Maize/Cassava	-	9.5	7.3	35.3	10.4
Rice	-	-	7.3	-	8.8
Cocoyam	-	-	7.3	4.1	8.8
Total Arable Crops	50.7	50.1	100.0	47.6	100.0
Cocoa	34.2	30.0	-	30.0	-
Kola	15.1	19.9	-	22.3	-
Total Tree Crops	49.3	49.9	-	52.3	-
Total	100.0	100.0	100.0	100.0	100.0
Average Cropped Area (ha) for Farm Class	7.38	4.70	4.36	2.36	2.40

Source: Farm Income and Resource Management in the Western State of Nigeria, Ministry of Agriculture and Natural Resources, Ibadan, June 1972.

Mid-Western State

7. Farming is generally carried out on a shifting cultivation basis with a typical bush-fallow cycle of about 7 years. Cultivation of food crops normally takes place over two or three seasons - mainly maize, yam and cassava, but also plantain and cocoyam - and is followed by a fallow period of four or five seasons. According to a Government survey in 1969, 1/ the average family holding in Urhobo West had about one ha under annual crops, with 46% of holdings having less than one ha.

1/ State Sample of Agricul Holdings, 1969.

8. However only a small proportion of the total cropped land is under annual crops. About 75% of the farmers in Urhobo (and probably a comparable proportion in the unsurveyed Agbor area) owned rubber plots, which accounted for no less than 88% of the total currently cropped area, with an average planting of 2.8 ha. However, as a result of low prices for rubber many farmers have ceased tapping and plots have been abandoned. Other tree crops found are kola and coconut.

9. Oil palm has been planted by a number of growers in the Sapele-Oghareki area, some of whom have quite substantial acreage and supply their fruit bunches to the Ajagbodudu Estate mill. In the Sapele area as a whole smallholders have some experience with oil palm as a planted crop. South of Agbor, on the other hand, farming patterns have tended more to food crops and - formerly at least - to rubber; while due to a combination of low yields and poor farmgate prices offered by dealers rubber is no longer so profitable, there is a thriving trade in cassava and yam to the markets of Agbor and Warri, and to achieve the desired response in this area, may therefore necessitate a higher intensity of extension effort.

East Central State

10. With an average farm size of less than one hectare (see Section C), most farms in the area are necessarily engaged in moderately intensive food crop production. Fallow periods are shorter than in the Western and Mid-Western States, typically around 3 years, ranging up to 5 years or more in the less densely populated parts and reportedly down to continuous cultivation in other parts (e.g. in Mbaise Division of Owerri) where there is increasing use of fertilizers on food crops.

11. Yam, maize, cassava and cocoyam are planted by the majority of farmers, with yam occupying the largest acreage, usually interplanted with maize or cocoyam. After yam and maize, cassava occupies the next largest acreage, and is mostly grown in pure stand. Probably a fairly high proportion of farmers supplement their incomes by tapping or harvesting the wild oil palms, which are found concentrated in the vicinity of the compounds. Wild palms are not normally felled, but may be intercropped with food crops when their density is not too high.

12. As compared with other States, a relatively large number of smallholders have successfully established small oil palm plantations using imported material and fertilizers. The East Central State Government in July 1972 launched an assisted Oil Palm Reclamation Program, which by the end of its first season had assisted 3,765 farmers to reclaim over 16,000 ha of oil palm, mostly planted shortly before the civil war which caused considerable damage. Probably up to 1,500 of these plantations are situated in the project area, covering some 4,000 ha or more. The average size of the individual plantations is about 4 ha, but a number of the larger ones are run as family or village community enterprises. It is likely that community plantations will provide a suitable form of participation in the project, provided individual family holdings can be clearly identified.

C. Farm Sizes

Western State

13. Distribution of farm sizes in the Western State is shown in a recent survey 1/ as follows:

Area under Cultivation per Farming Household, Western State

	1968/69	1969/70	1970/71
ha	0.91	0.96	0.86

Percentage of Farming Households by Size of Farm

Size of Farm (ha)			
Under 0.1	11	9	28
0.1 - 0.2	16	14	28
0.2 - 0.4	24	19	24
0.4 - 1.0	32	33	16
1.0 - 2.0	13	18	3
2.0 - 4.0	4	6	1
Over 4.0	..	1	..
	100	100	100

(.. less than 0.5 percent)

The survey indicated that, over the State as a whole, some 45% of farms included a tree crop, at least during the first two years of the survey, though in the third year the proportion apparently fell to only 24%. This change, and the apparent sharp reduction in farm size in 1970/71, is not explained in the survey report.

14. The farm survey carried out by the Ministry of Agriculture in 1972 does not provide data on distribution of farm sizes, but gives an average cultivated area of 0.93 ha. It shows that farmers growing cassava (in the project area, virtually all) planted an average of 0.55 ha to this crop. Similar figures for maize were 0.61 ha (probably less in the project area) and yam 0.26 ha.

15. Another detailed report by the Ministry shows a much higher average size for small arable farms in the southern rain forest zone of 2.4 hectares, but it is not clear whether this was based on actual survey or taken as a model for farm management studies.

1/ Farm Income and Resource Management in the Western State of Nigeria, Ministry of Agriculture and Natural Resources, Ibadan, June, 1972.

16. However, whether the actual figure for average farm size in the project area is nearer 1 or 2 hectares, a minimum planting under the project of 1 hectare of oil palm is likely to attract farmers who have larger areas or who are more progressive.

Mid-Western State

17. Average size of total area under cultivation, both arable and tree crops, is estimated at 3 to 4 ha, probably nearer 4 ha in the Sapele area and 3 ha in the Agbor area. Average farm family size in Urhobo Division is around 6 to 7 persons (Ika Division not surveyed but probably about the same); average time spent per year on agricultural work was recorded as 8 months for adults (State average 7.3) and 1.6 months for juveniles (6-15 years).

18. Families devote an average of about 1 ha to arable crops. Size distribution of arable crops in holdings in Western Urhobo, 1969/70 is shown below, based on a study of 20 villages. 1/

Size (ha)			Percentage	
0	-	0.4	15.4	
0.4	-	0.8	27.2	
0.8	-	1.2	17.1	
1.2	-	1.6	13.0	
1.6	-	2.0	6.6	
2.0	-	2.4	8.9	
2.4	-		11.8	
			100.0	(average:1.2 ha)

19. Size distribution of rubber acreage in Urhobo holdings (1969/70) is shown below: 1/

Size (ha)			Percentage	
0	-	0.8	15.4	
0.8	-	1.6	15.7	
1.6	-	2.4	16.8	
2.4	-	3.2	8.9	
3.2	-	4.0	9.6	
4.0	-	4.9	3.2	
4.9	-		20.4	
			100.0	(average:2.6 ha)

1/ Data by inquiry, State Sample Survey of Agricultural Holdings, 1969.

East Central State

20. Official data on farm sizes in the East Central State is sketchy, and the State Government is still in process of carrying out its farm survey. Cropping is more intensive than in other parts of the Southern Nigerian oil palm belt and farm sizes are generally smaller; but it is difficult to reconcile figures for the State given in the Federal Rural Economic Survey for 1970/71 which show an average cultivated area per farm family of only 0.28 ha (and 0.18 ha per farmer) with estimates by local officials 1/ that most farmers in the area would plant at least 1 ha to food crops. It is certainly hard to believe that, as shown in the Rural Economic Survey report, over 80% of the 4 million farms in East Central State are less than 0.1 hectares. 2/

21. On the other hand, with a population density of the order of 400 per sq kilometer, of whom probably in the region of 80% belong to farming households and with only a similar percentage of the total land area at most will be suitable for cultivation, only 0.25 ha per person of useable land can be available. With an average household size of around 6 and an average cropping intensity allowing for fallow periods of 0.5, this implies an average farm size per family of not more than 0.75 ha. With a higher than average level of labor input this area is sufficient to supply a family with its normal food requirements. (The preliminary results of the pilot stage of the State Rural Economic Survey carried out in Oguta Division, part of which is in the project area, show an average holding size of about 0.4 ha.)

22. Certainly the above sort of average calculation must conceal considerable local variations within the project area. However, it does suggest, that in the most densely populated areas, a minimum planting of one hectare of oil palm under the project is likely to attract farmers with larger than average size farms, or those who already have some alternative forms of employment to provide for their family subsistence. During appraisal the Cooperative Division of the Ministry of Trade and Industries indicated that community land could be more readily released to cooperatives for development by their members, than to individuals.

1/ e.g. In "A Preliminary Study of the Farming Systems in Owerri, Aba and Umuahia Areas of the East Central State". Ministry of Agriculture, Enugu, November 1973.

2/ Food farms in East Central State tend to be dispersed and fragmented and it seems possible that the Rural Economic Survey failed to identify all the plots pertaining to the households surveyed.

D. Farm Incomes

Derivation of Farm Budgets

23. The smallholder farm budgets (for details see tables 2 to 17), summarized for the different States in the tables below show comparative costs and returns for oil palm and seven 1/ other crops or crop combinations, under conditions of existing general levels of management and under improved management.

1/ In the case of Western and Mid-Western States. Only six crops or crop combinations in East Central State since rubber as an alternative crop has not been included in that State.

Comparison of Farmer Returns per ha in Western State

	Gross Margin (a)	Gross Margin (b)	Return to Management	Return to Management and Labor (c)	Return to Management and Labor (d)
	(Naira per ha)				(₦/manday)
Existing Management					
Maize	95.3	35.7	-33.2	71.8	0.48
Yam	310.5	116.4	114.2	268.2	1.22
Cassava	144.8	54.3	16.0	121.0	0.81
Maize/Cassava	184.0	69.0	48.2	160.2	1.00
Yam/Maize	320.8	120.3	114.1	282.1	1.18
Rubber	32.5	32.5	-38.5	23.1	0.26
Kola	49.5	49.5	1.5	40.7	0.73
Oil Palm (wild grove)	57.0	57.0	26.0	47.0	1.57
Improved Management					
Maize	177.0	66.4	- 4.3	153.2	0.68
Yam	443.0	166.1	219.0	394.0	1.58
Cassava	279.0	104.6	113.6	253.6	1.27
Maize/Cassava	314.5	117.9	160.3	289.8	1.57
Yam/Maize	427.8	160.4	191.8	384.3	1.40
Rubber	82.5	82.5	-28.7	72.8	0.50
Kola	199.0	199.0	141.2	190.2	2.72
Oil Palm (planted)	185.0	185.0	154.4	175.4	5.85

Gross Margin: (a) per ha of land cultivated
(b) per ha of total land employed including fallow

Return to Management: after deduction of interest on annual capital employed and national rent on total land-use

Return to Management and Labor: (c) per ha of land cultivated
(d) per manday

Comparison of Farmer Returns per ha in Mid-Western State

	Gross Margin (a)	Gross Margin (b)	Return to Management	Return to Management and Labor (c)	Return to Management and Labor (d)
	..... (Naira per ha)				(₦/manday)
Existing Management					
Maize	95.3	40.8	- 47.8	57.2	0.83
Yam	310.5	133.1	99.6	253.6	1.15
Cassava	144.8	62.1	1.4	106.4	0.71
Maize/Cassava	184.0	78.9	33.6	145.6	0.91
Yam/Maize	320.8	137.5	99.5	267.5	1.11
Rubber	32.5	32.5	- 46.0	15.6	0.18
Kola	49.5	49.5	- 6.0	33.2	0.59
Oil palm (wild grove)	57.0	57.0	18.5	39.5	1.32
Improved Management					
Maize	177.0	75.9	- 18.9	138.6	0.62
Yam	443.0	189.9	204.4	379.4	1.52
Cassava	279.0	119.6	99.0	239.0	1.19
Maize/Cassava	314.5	134.8	145.7	275.2	1.49
Yam/Maize	427.8	183.3	177.2	369.7	1.34
Rubber	82.5	82.5	- 36.2	65.3	0.45
Kola	199.0	199.0	133.7	182.7	2.61
Oil palm (planted)	185.0	185.0	146.9	167.9	5.60

Gross Margin: (a) per ha of land cultivated
(b) per ha of total land employed including fallow

Return to Management: after deduction of interest on annual capital employed and national rent on total land-use

Return to Management and Labor: (c) per ha of land cultivated
(d) per manday

Comparison of Farmer Returns per ha

East Central State

	Gross Margin (a)	Gross Margin (b)	Return to Management	Return to Management and Labor (c)	Return to Management and Labor (d)
	(Naira per ha)				
Existing Management					
Maize	95.3	47.7	- 52.4	45.1	0.30
Yam	310.5	155.3	98.5	241.5	1.10
Cassava	144.8	72.4	- 3.2	94.3	0.63
Maize/Cassava	184.0	92.0	29.5	133.5	0.83
Yam/Maize	320.8	160.4	99.4	255.4	1.06
Kola	49.5	49.5	- 11.9	24.5	0.44
Oil Palm (wild grove)	57.0	57.0	11.3	30.8	1.03
Improved Management					
Maize	177.0	88.5	- 19.8	126.5	0.56
Yam	443.0	221.5	204.8	367.3	1.47
Cassava	279.0	139.5	96.9	226.9	1.13
Maize/Cassava	314.5	157.2	142.8	263.1	1.42
Yam/Maize	427.8	213.9	178.8	357.6	1.30
Kola	199.0	199.0	128.5	174.0	2.49
Oil Palm (planted)	175.0	175.0	129.7	149.2	4.97

Gross Margin: (a) per ha of land cultivated
(b) per ha of total land employed including fallow

Return to Management: after deduction of interest on annual capital employed and national rent on total land-use

Return to Management and Labor: (c) per ha of land cultivated
(d) per manday

24. Insufficient data exist to permit a regional differentiation of purchased input factors, yields or farm-gate prices. Instead an amalgam of available data from all three States (Western, Mid-Western and East Central States) is used to reflect typical sets of parameters applying to smallholder farmers in the oil palm belt as at 1973. The budgets cannot therefore be expected to provide precise data for any particular area or future time. Where other data were not available, derivations of yields and input factors relied heavily on a study prepared by Western State Ministry of Agriculture, "Production, Production Requirements, Costs and Returns of Crops: Southern Rain Forest Zone, Western State of Nigeria." (Ibadan, March 1972).

25. Labor and land were, however, costed differently for the three States. Labor was costed at the full estimated current smallholder wage rate of 70 kobo per manday in Western and Mid-Western States, and 65 kobo in East Central State. For land an imputed rental cost was calculated for each State to reflect differential land values, so far as they could be estimated, and (for arable crops) differing intensities of cropping (i.e. longer or shorter fallow periods). On the same principle, gross margins for each crop are shown per hectare of total land employed (cultivated plus fallow) to reflect the more intensive use of land under a permanent tree crop. (See Appendix 1 - Calculation of Land Use Rents). For tree crops (oil palm, rubber and kola) the budgets reflect an annual return in maturity and do not include a deduction for amortization of original costs of establishment.

26. For comparison a farm budget for mature planted oil palm is shown on a similar basis, using input-output factors assumed for the project but assuming the project grant/credit receipts and repayments have been completed. Since the costing includes imputed costs for land and annual capital it is not directly comparable with the project smallholder farm budget on a cash-flow basis shown in the appraisal reports.

27. Other detailed notes:

(a) Labor costs - valued at estimated current rates, i.e. not shadow-priced. Shadow-pricing would raise the returns to management but leave the returns to management and labor unchanged.

(b) Fertilizer-costed at ₦ 2.00 per 50 kg bag in each State, assuming a subsidy of 50%; in East Central State the rate of subsidy is presently 70% but is assumed to be reduced to 50% by the time the project is established.

(c) Assumed yield rates, labor requirements and farmgate prices are shown in Table 1.

Results of Farm Budgets

28. Under both existing and improved management yam is the most profitable single crop, and yam/maize the most profitable crop combination, due to the relatively high prices reported for yam, which outweigh the higher yields obtainable in cassava. With improved management yam/maize gives a gross margin per hectare comparable with or higher than planted oil palm, even after allowing for fallow land employed. However the high labor requirement for yam results in a return per manday of only about ₦ 1.50 compared with ₦ 5.00 - 6.00 derived for planted oil palm, which shows the highest return on a manday basis.

29. Comparing tree crops, kola appears to yield a higher return on a yield of 2,000 kg/ha than planted oil palm, but again because of its higher labor requirements shows a lower return per manday. Owing to the low price currently being paid in Nigeria, rubber is very much less profitable than oil palm; based on expected world prices it ought, however, to be comparable. While the harvesting of wild oil palm provides the highest return per manday of all the enterprises under existing management (₦ 1.00 - 1.50) it is about four times higher on planted palms once they reach full bearing.

Farm Incomes

30. Official data on smallholder farm incomes is sketchy. However the comparative farm budgets and a preliminary study carried out in the East Central project area 1/ suggest that typical arable smallholdings of about 1 ha in the oil palm belt may earn a gross return of between ₦ 150 and ₦ 300 2/ from arable crops, of which some ₦ 100 - 200 might be the value of food for household consumption. This income may be augmented by perhaps another ₦ 50 where farmers plant a cash crop or harvest wild palm or rubber. It is therefore clear that a planting of 1 ha oil palm with an annual return to management and labor of about ₦ 175 in the Western State, ₦ 168 in the Mid-Western State, and ₦ 150 in East Central State 3/ in maturity would represent a very considerable addition to the income of an average or medium-scale smallholding.

1/ "A Preliminary Study of the Farming System in Owerri, Aba and Umuahia Areas of the East Central State." Ministry of Agriculture, Enugu, November 1973.

2/ Per capita around ₦ 40.

3/ This is based on the farm budget in Table 17 of this Supplement, which differs from the farm budget in the appraisal reports, where no deduction is made for imputed land rent and capital costs (see para 26).

E. Farm Family Labor Availability

31. A typical farming family of about seven persons would probably comprise around 2-1/2 man-units in terms of labor capacity. At periods of peak labor demand the family might be expected to work on the farm up to 20 days in a month, giving a peak month labor supply of around 50 man-days. A typical holding of one ha of food crops under normal management is estimated to require about 200 mandays labor in the year, with a peak monthly labor demand over March-April-May of about 30 mandays, leaving a potential spare labor capacity of 20 mandays even in a peak month.

32. The period of peak labor demand for mature oil palm tends to overlap with that for food crops, as a result both of peak monthly yields (normally occurring about May) and of rapid weed growth after onset of the rains. It is estimated that labor requirements for harvesting and maintenance over the months April-May-June would normally be about 5 mandays per ha per month on a holding in full bearing. Given that a hectare of food crops would still allow a monthly labor availability of not less than 20 mandays at this time, it suggests that after establishment, a farm family could maintain a planting of oil palm of up to four ha without normally having to hire additional labor during the peak labor months.

33. Annual labor requirements for oil palm are naturally higher and also more concentrated during the early years. In the year of planting, operations estimated to require over 50 mandays per ha 1/ must be accomplished over the three months February-March-April, with a peak monthly demand approaching 20 mandays. Consequently an average family would normally have to hire additional labor during this period for a planting in excess of 1 ha. Over the remaining immature years a family could be expected to maintain at least 2 ha of palms, as well as its food crops, without hire labor.

1/ Stacking, burning, clearing rows, lining, weeding avenues, planting cover, holing and refilling, planting, fixing wire-collars, amount to an estimated 52 mandays/ha.

SUPPLEMENT 2
Appendix 1

NIGERIA

OIL PALM PROJECTS

Calculation of Land Use Rents in Farm Budgets

1. Estimates of annual rental value of arable land:

Western State: ₦ 3.50 per ac = ₦ 8.75 per ha (Ministry of Agriculture, Ibadan)

Mid-Western State: ₦ 6.50 per ac = ₦ 16.25 per ha (mission estimate)

East Central State: ₦ 10.00 per ac = ₦ 25.00 per ha (mission estimate)

2. Estimates of typical bush-fallow rotation periods (based on information from State Ministries of Agriculture, farmers and other local sources):

Western State: 8 years (range 7 to 10 includes cultivation plus fallow)

Mid-Western State: 7 years (range 6 to 8 includes cultivation plus fallow)

East Central State: 6 years (range 3 to 8 includes cultivation plus fallow)

3. It is estimated that the cultivation period within the cycle is typically 3 years with a fallow of 5 years in Western State, 4 years in Mid-Western State and 3 years in East Central State. The data available do not permit a regional differentiation of yield estimates; but since the assumed yields obtainable depend upon the above fallow periods, it is only reasonable to charge against the operations the opportunity-cost (taking reported annual rents as a proxy) of land thereby kept idle.

4. For a 12-month crop 1/ rent on land use is therefore estimated as follows:

Western State: 8/3 x 8.75 = 23.33 (₦ per ha)

Mid-West State: 7/3 x 16.25 = 37.92 (₦ per ha)

East Central State: 6/3 x 25.00 = 50.00 (₦ per ha)

1/ While all the main arable crops, particularly maize, may be harvested in less than 12 months from land preparation, they all occupy one full growing season, and, apart from a late crop of maize in some areas, effectively occupy the land for virtually a full year. Therefore while not strictly accurate, a full year's rent on land use is charged against each crop.

5. The return to management and labor, after deducting cash expenses and the costs of annual capital and land employed (calculated as above), represents the net value per ha of the enterprise to the farmer and his family, assuming they provide all the labor.

6. For comparison with oil palm, a value of the gross margin per ha of total land employed is also shown, calculated by multiplying the basic gross margin estimate by a factor denoting the intensity of cropping in the bush-fallow cycle, viz:

Western State:	37.5%
Mid-Western State:	42.9%
East Central State:	50.0%

NIGERIA

OIL PALM PROJECTS

Yields, Labor Requirements and Farmgate Prices Assumed in Farm Budgets /1

	Yield kg per ha	Labor Input mandays per ha	Price ₦ per 1,000 kg /2	
Existing Management				
Maize	1,000	150	100	
Yam	6,250	220	80	
Cassava	7,500	150	20	
Maize/Cassava	750	160	100	
	5,750	-	20	
Yam/Maize	5,000	240	80	
	750	-	100	
Rubber	450	88	100	
Kola	500	56	100	
Oil palm (oil)	250	30	200	
(kernels)	125		50	
Improved Management				
Maize	1,875	225	100	
Yam	8,750	250	80	
Cassava	15,000	200	20	
Maize/Cassava	1,000	185	100	
	11,625		20	
Yam/Maize	6,500	275	80	
	1,100	-	100	
Rubber	1,000	145	100	
Kola	2,000	70	100	
Oil palm (ffb)	10,000	30	20	(W, MW)
			19	(EC)

/1 Mission estimate.

/2 Mission estimate of average farmgate price.

NIGERIA

OIL PALM PROJECTS

Farm Budget

Sole Cropped Maize, Existing Management

		(₦/ha)
Gross Revenue		
1.0 ton maize grain at ₦ 100 per ton		100.0
Cash Costs		
18 kg maize seed at 15 kobo/kg		2.7
Tools and equipment		2.0
		4.7
Gross Margin		95.3
Labor Costs		
All field, harvesting and shelling operations estimated 150 days at 70 kobo (W, MW)		105.0
65 kobo (EC)		97.5
Return to Capital, Land + Management		
W, MW		- 9.7
EC		- 2.2
Interest on Capital Employed (6 months at 10%)		0.2
Rent on Land Use		
W		23.3
MW		37.9
EC		50.0
Return to Management		
W		- 33.2
MW		- 47.8
EC		- 52.4
Add: Labor Costs		
Return to Management and Labor	₦ per manday	
W	0.48	71.8
MW	0.38	57.2
EC	0.30	45.1
Gross Margin per ha total land employed		
W		35.7
MW		40.8
EC		47.7

NIGERIA

OIL PALM PROJECTS

Farm Budget

Sole Cropped Yam, Existing Management

	(₦/ha)
Gross Revenue	
6.25 tons yam tubers at ₦ 80/ton	500.0
Cash Costs	
1.875 tons yam sets at ₦ 100/ton	187.5
Tools and equipment	2.0
	189.5
Gross Margin	310.5
Labor Costs	
All field and harvesting operations estimated	
220 days at 70 kobo (W, MW)	154.0
65 kobo (EC)	143.0
Return to Capital, Land + Management	
W, MW	156.5
MW	167.5
Interest on Capital Employed (12 months at 10%)	19.0
Rent on Land Use	
W	23.3
MW	37.9
EC	50.0
Return to Management	
W	114.2
MW	99.6
EC	98.5
Add: Labor Costs	
Return to Management + Labor	
₦ per manday	
W 1.22	268.2
MW 1.15	253.6
EC 1.10	241.5
Gross Margin per ha total land employed	
W	116.4
MW	133 1
EC	155 3

Supplement 2
Table 4

NIGERIA

OIL PALM PROJECTS

Farm Budget

Sole Cropped Cassava, Existing Management

		(₦/ha)
Gross Revenue		
7.5 tons		150.0
Cash Costs		
Cassava cutting, 8 bundles at 40 kobo		3.2
Tools and Equipment		2.0
		5.2
Gross Margin		144.8
Labor Costs		
All field and harvesting operations estimated at 150 days		
at 70 kobo (W, MW)		105.0
65 kobo (EC)		97.5
Return to Capital, Land + Management		
W, MW		39.8
EC		47.3
Interest on Capital Employed (1 year at 10%)		0.5
Rent on Land Use		
W		23.3
MW		37.9
EC		50.0
Return to Management		
W		16.0
MW		1.4
EC		- 3.2
add: Labor Costs		
Return to Management + Labor		
	₦ per manday	
W	0.81	121.0
MW	0.71	106.4
EC	0.63	94.3
Gross Margin per ha total land employed		
W		54.3
MW		62.1
EC		72.4

NIGERIA

OIL PALM PROJECTS

Farm Budget

Maize Intercropped with Cassava, Existing Management

		(₦/ha)
Gross Revenue		
750 kg maize grain at 10 kobo/kg		75.0
5,750 kg cassava tubers at 2 kobo/kg		115.0
		190.0
Cash Costs		
15 kg maize seed at 15 kobo/kg		2.2
4-1/2 bundles cassava cutting at 40 kg		1.8
tools and equipment		2.0
		6.0
Gross Margin		184.0
Labor Costs		
160 mandays at 70 kobo (W, MW)		112.0
65 kobo (EC)		104.0
Return to Capital, Land + Management		
W, MW		72.0
EC		80.0
Interest on Capital Employed (9 months at 10%)		0.5
Rent on Land Use		
W		23.3
MW		37.9
EC		50.0
Return to Management		
W		48.2
MW		33.6
EC		29.5
add: Labor Costs		
Return to Management + Labor	₦ per manday	
W	1.00	160.2
MW	0.91	145.6
EC	0.83	133.5
Gross Margin per ha total land employed		
W		69.0
MW		78.9
EC		92.0

NIGERIA

OIL PALM PROJECTS

Farm Budget

Yam Intercropped with Maize, Existing Management

		(₦/ha)
Gross Revenue		
5 tons yam tubers at ₦ 80/ton		400.0
0.75 ton maize grain at ₦ 100/ton		75.0
		475.0
Cash Costs		
1.5 tons yam sets at ₦ 100/ton		150.0
15 kg maize seed at 15 kobo/kg		2.2
Tools and equipment		2.0
		154.2
Gross Margin		320.8
Labor Costs 240 mandays at 70 kobo (W, MW)		168.0
65 kobo (EC)		156.0
Return to Capital, Land & Management		
W, MW		152.8
EC		164.8
Interest on Capital Employed (12 months at 10%)		15.4
Rent on Land Use		
W		23.3
MW		37.9
EC		50.0
Return to Management		
W		114.1
MW		99.5
EC		99.4
add: Labor Costs		
Return to Management + Labor		
	₦ per manday	
W	1.18	282.1
MW	1.11	267.5
EC	1.06	255.4
Gross Margin per ha total land employed		
W		120.3
MW		137.5
EC		160.4

Supplement 2
Table 7

NIGERIA

OIL PALM PROJECTS

Farm Budget

Rubber, Mature Traditional Plantation (Existing Management)

	(₦/ha)
Gross Revenue	
450 kg of dry rubber at 10 kobo/kg	45.0
Cash Costs	
tapping equipment & chemicals	12.5
Gross Margin	32.5
Labor Costs	
Tapping, carrying, fire control, slashing and weeding	
88 mandays at 70 kobo (W, MW)	61.6
Return to Capital, Land + Management	- 29.1
Interest on Capital Employed (6 months at 10%)	0.6
Rent on Land Use	
W	8.8
MW	16.3
Return to Management /1	
W	- 38.5
MW	- 46.0
add: Labor Costs	
Return to Management + Labor	
W	23.1
MW	15.6

	₦ per manday
W	0.26
MW	0.18

1/ Annual amortization of establishment cost not deducted.

NIGERIA

OIL PALM PROJECTS

Farm Budget

Mature Kola Nut Plantation (Traditional)

		(N/ha)
Gross Revenue		
500 kg fresh kola nuts at 10 kobo/kg		50.0
Cash Costs tools and baskets		0.5
Gross Margin		49.5
Labor Costs (weeding, harvesting, carrying processing)		
56 mandays at 70 kobo (W, MW)		39.2
at 65 kobo (EC)		36.4
Return to Capital, Land + Management		
W, MW		10.3
EC		13.1
Rent on Land Use		
W		8.8
MW		16.3
EC		25.0
Return to Management /1		
W		1.5
MW		- 6.0
EC		- 11.9
Add: Labor Costs		
Return to Management + Labor	N per manday	
W	0.73	40.7
MW	0.59	33.2
EC	0.44	24.5

1/ Annual amortization of establishment cost not deducted.

NIGERIA

OIL PALM PROJECTS

Farm Budget

Wild Grove Oil Palm (Traditional Processing)

	(N/ha)
Gross Revenue	
(a) 2,500 kg fresh fruit bunches	
(b) 1,250 kg fruit /2	
(c) 250 kg palm oil at 20 kobo/kg /3	50.0
(d) 125 kg palm kernels at 5 kobo/kg /4	6.3
	56.3
Cash Costs Tools and equipment	0.5
Gross Margin	55.8
Labor Costs (slashing avenues, harvesting, carrying and processing)	
30 mandays at 70 kobo (W, MW)	21.0
65 kobo (EC)	19.5
Return to Land and Management	
W, MW	34.8
EC	36.3
Rent on Land Use	
W	8.8
MW	16.3
EC	25.0
Return to Management	
W	26.0
MW	18.5
EC	11.3
add: Labor Costs	
Return to Management and Labor	
W	47.0
MW	39.5
EC	30.8

	₦ per manday
W	1.57
MW	1.32
EC	1.03

/1 No intercropping with foodcrops assumed.
/2 Ratio fruit/bunch assumed 0.5.
/3 Oil extraction rate of 10% of ffb assumed.
/4 Kernel extraction rate of 5% of ffb assumed.

NIGERIA

OIL PALM PROJECTS

Farm Budget

Sole Cropped Maize, Improved Management

		(₦/ha)
Gross Revenue		
	1.875 tons dry maize grain at ₦ 100 per ton	187.5
Cash Costs		
	23 kg seed at 15 kobo/kg	3.5
	Fertiliser 2-1/2 bags at ₦ 2 (subsidised)	5.0
	Tools, baskets, etc.	2.0
		10.5
Gross Margin		177.0
Labor Costs	all field, harvesting & shelling operations	
	Estimated at 225 days at 70 kobo (W, MW)	157.5
	at 65 kobo (EC)	146.3
Return to Capital, Land + Management		
	W, MW	19.5
	EC	30.7
Interest on Capital Employed (6 months at 10 %)		0.5
Rent on Land Use		
	W	23.3
	MW	37.9
	EC	50.0
Return to Management		
	W	- 4.3
	MW	- 18.9
	EC	- 19.8
add: Labor Costs		
Return to Management and Labor		
	₦ per manday	
M	0.68	153.2
MW	0.62	138.6
EC	0.56	126.5
Gross Margin per ha total land employed		
	W	66.4
	MW	75.9
	EC	88.5

NIGERIA

OIL PALM PROJECTS

Farm Budget

Sole Cropped Yam, Improved Management

		(₦/ha)
Gross Revenue		
	8.75 tons yam tubers at ₦ 80/ton	700.0
Cash Costs		
	2.5 tons yam sets at ₦ 100/ton	250.0
	Fertiliser 2-1/2 bags of 50 kg at ₦ 2 (subsidized)	5.0
	Tools and equipment	2.0
		257.0
Gross Margin		443.0
Labor Costs	all field and harvesting operations	
	Estimated 250 days at 70 kobo (W, MW)	175.0
	65 kobo (EC)	162.5
Return to Capital, Land + Management		
	W, MW	268.0
	EC	280.5
Interest on Capital Employed (12 months at 10 %)		25.7
Rent on Land Use		
	W	23.3
	MW	37.9
	EC	50.0
Return to Management		
	W	219.0
	MW	204.4
	EC	204.8
Add: Labor Costs		
Return to Management + Labor		
	₦ per manday	
W	1.58	394.0
MW	1.52	379.4
EC	1.47	367.3
Gross Margin per Ha total land employed		
	W	166.1
	MW	189.9
	EC	221.5

NIGERIA

OIL PALM PROJECTS

Farm Budget

Sole Cropped Cassava, Improved Management

		(₦/ha)
Gross Revenue		
	15 tons cassava tubers at ₦ 20/ton	300.0
Cash Costs		
	Cassava cutting (improved variety)	4.0
	10 bundles of 1,000 at 40 kobo fertilizer	
	7-1/2 bags/ha of 50 kg at ₦ 2.00/bag (subsidized price)	15.0
	Tools and baskets	2.0
		21.0
Gross Margin		279.0
Labor Costs	All field and harvesting costs	
	Estimated 200 days at 70 kobo (W, MW)	140.0
	at 65 kobo (EC)	130.0
Return to Capital, Land, Management		
	W, MW	139.0
	EC	149.0
Interest on Capital Employed (1 year at 10%)		2.1
Rent on Land Use		
	W	23.3
	MW	37.9
	EC	50.0
Return to Management		
	W	113.6
	MW	99.0
	EC	96.9
Add: Labor Costs		
Return to Management and Labor		
	₦ per manday	
	W 1.27	253.6
	MW 1.19	239.0
	EC 1.13	226.9
Gross Margin per ha total land employed		
	W	104.6
	MW	119.6
	EC	139.5

NIGERIA

OIL PALM PROJECTS

Farm Budget

Maize Intercropped with Cassava, Improved Management

		(₦/ha)
Gross Revenue		
	1.0 ton maize grain at ₦ 100/ton	100.0
	11.625 tons cassava at ₦ 20/ton	232.5
		332.5
Cash Costs		
	15 kg maize seed at 15 kobo/kg	2.2
	4-1/2 bundles cassava cuttings at 40 kobo	1.8
	6 bags fertilizer at ₦ 2.0 (subsidized)	12.0
	tools and equipment	2.0
		18.0
Gross Margin		314.5
Labor Costs	185 mandays at 70 kobo (W, MW)	129.5
	65 kobo (EC)	120.3
Return to Capital, Land + Management		
	W, MW	185.0
	EC	194.2
Interest on Capital Employed (9 months at 10%)		1.4
Rent on Land Use		
	W	23.3
	MW	37.9
	EC	50.0
Return to Management		
	W	160.3
	MW	145.7
	EC	142.8
Add: Labor Costs		
Return to Management + Labor		
	₦ per manday	
W	1.57	289.8
MW	1.49	275.2
EC	1.42	263.1
Gross Margin per ha total land employed		
	W	117.9
	MW	134.8
	EC	157.2

NIGERIA

OIL PALM PROJECTS

Farm Budget

Yam Intercropped with Maize, Improved Management

		(₦/ha)
Gross Revenue		
	6.5 tons yam tubers at ₦ 80/ton	520.0
	1.1 tons maize grain at ₦ 100/ton	110.0
		630.0
Cash Costs		
	1.9 tons yam sets at ₦ 100/ton	190.0
	15 kg maize seed at 15 kobo/kg	2.2
	4 bags fertilizer at ₦ 2 (subsidized)	8.0
	tools and equipment	2.0
		202.2
Gross Margin		427.8
Labor Costs	275 mandays at 70 kobo (W, MW)	192.5
	65 kobo (EC)	178.8
Return to Capital, Land + Management		
	W, MW	235.3
	EC	249.0
Interest on Capital Employed (12 months at 10%)		20.2
Rent on Land Use		
	W	23.2
	MW	37.9
	EC	50.0
Return to Management		
	W	191.8
	MW	177.2
	EC	178.8
Return to Management + Labor		
	₦ per manday	
	W 1.40	384.3
	MW 1.34	369.7
	EC 1.30	357.6
Gross Margin per ha total land employed		
	W	160.4
	MW	183.3
	EC	213.9

NIGERIA

OIL PALM PROJECTS

Farm Budget

Rubber, Mature Plantation, Improved Management

		(₦/ha)
Gross Revenue		
1,000 kg dry rubber at 10 kobo/kg		100.0
Cash Costs		
Chemicals and tapping equipment		17.5
Gross Margin		82.5
Labor Costs All operations		
145 mandays at 70 kobo (W, MW)		101.5
Return to Capital, Land + Management		- 19.0
Interest on Capital Employed (6 months at 10%)		0.9
Rent on Land Use		
W		8.8
MW		16.3
Return to Management /1		
W		- 28.7
MW		- 36.2
Add: Labor Costs		
Return to Management + Labor		
	₦ per manday	
W	0.50	72.8
MW	0.45	65.3

1/ Annual amortization of establishment cost not deducted.

NIGERIA

OIL PALM PROJECTS

Farm Budget

Kola Nut, Mature Plantation, Improved Management

		(₦/ha)
Gross Revenue		
	2,000 kg fresh kola nuts at 10 kobo/kg	200.0
Cash Costs		
	Tools and baskets	1.0
Gross Margin		199.0
Labor Costs		
	70 mandays at 70 kobo (W, MW)	49.0
	65 kobo (EC)	45.5
Return to Capital, Land + Management		
	W, MW	150.0
	EC	153.5
Rent on Land Use		
	W	8.8
	MW	16.3
	EC	25.0
Return to Management /1		
	W	141.2
	MW	133.7
	EC	128.5

add: Labor Costs

Return to Management + Labor	₦ per manday	
W	2.72	190.2
MW	2.61	182.7
EC	2.49	174.0

1/ Annual amortization of establishment cost not deducted.

NIGERIA

OIL PALM PROJECTS

Farm Budget

Mature Oil Palm Plantation, Improved Management (Project) /1

	(₦/ha)
Gross Revenue	
10 tons fresh fruit bunches at ₦ 20.0 (W, MW)	200.0
₦ 19.0 (EC)	190.0
Cash Costs	
200 kg muriate of potash at 5 kobo/kg /2	10.0
Insecticides, fungicides	2.5
Tools and equipment	2.5
	15.0
Gross Margin	
W, MW	185.0
EC	175.0
Labor Costs	
30 mandays at 70 kobo (W, MW)	21.0
65 kobo (EC)	19.5
Return to Capital, Land + Management	
W, MW	164.0
EC	155.5
Interest on Capital Employed (6 months at 10%)	0.8
Rent on Land Use	
W	8.8
MW	16.3
EC	25.0
Return to Management /3	
W	154.4
MW	146.9
EC	129.7
add: Labor Costs	

Return to Management and Labor	₦ Per manday	
W	5.85	175.4
MW	5.60	167.9
EC	4.97	149.2

/1 After completion of project credit repayment.
/2 Assuming 50% subsidy.
/3 Annual amortization of establishment cost not deducted.

NIGERIA

OIL PALM PROJECTS

Federal Institutions [1/]

1. Federal Ministry of Agriculture and Natural Resources. Agricultural development in Nigeria is the responsibility of thirteen separate governments - the Federal government and twelve State governments. The Federal Ministry of Agriculture and Natural Resources (FMANR) is responsible for overall coordinating of agricultural development. It funds the State ministries of agriculture allocating 30% of available funds on a one-twelfth basis and 70% on the basis of population. 2/ Besides these allocations, FMANR provides special grants for approved development schemes.

2. The Federal Department of Agriculture (FDA) is one of the departments under FMANR, and it works through three divisions: (i) land and water resources division; (ii) planning division; and (iii) crop production division. The proposed Monitoring and Evaluation Unit would report to the Director of FDA through the planning division.

3. The Universities of Ibadan, Ife, Nigeria - Nsukwa and Ahmadu Bello have well established faculties of agriculture, and student enrollment for degree courses is currently running at around the 1,200 level. In recent years about half of the agricultural graduates have not gone into public sector agricultural employment - many tending to remain in the urban areas. Though shortages may occur from time to time, it would seem that only limited expansion of university level agricultural education will be needed to meet future requirements. 3/ However, if the right type of agricultural officer material is to be forthcoming, the standards applied at initial student selection may need to be raised and also career opportunities for graduates should be made more progressive and financially competitive with other occupations.

4. For successful project implementation it is essential to have sufficient well trained middle level technicians to execute programs at "grass roots" farm level. The main sources of supply of Assistant Agricultural Superintendents (diploma) and Agricultural Assistants (certificate) are the Schools of Agriculture at Moor Plantation, Ibadan, Akure, Umudike and Obubra. At this juncture the Western, Mid-Western, and East Central States do not appear to be experiencing any major shortfall in these categories of field staff.

1/ State Institutions involved in the projects are described the appraisal reports.

2/ On Independence day 1974, FMG announced that allocation of funds to the States would be 50% on the basis of population and 50% on the basis of equality.

3/ IBRD/UNESCO Education Sector Mission.

However, a large number of extensive development programs are scheduled for the agricultural sector during the next few years. Given this situation, it is essential that detailed and continuous assessments are made well in advance so as to ensure that the supply and quality of middle level field staff meets the requirements of on-going and planned programs.

5. In addition to receiving a basic training at universities and Schools of Agriculture, field staff would also receive training through special in-service courses designed to meet the specific need of the projects they are concerned with.

6. Nigerian Agricultural Bank. Federal Government's most important step towards the development of agricultural credit has been the creation of the Nigerian Agricultural Bank (NAB), which is the first Federal institution organized solely to provide finance for agriculture. NAB was registered under the Companies Act in November 1972; and it was officially inaugurated in early 1973. The head office of NAB is in Kaduna, the capital of the North Central State. The main objects of the NAB are set out in its Memorandum of Association as follows:

"(a) To grant loans for agricultural production (including horticulture, poultry farming, pig breeding, fisheries, forestry and timber production, animal husbandry and any other type of farming) and for purposes of storage, distribution and marketing connected with such production to any state, group of states, or any state institution for on-lending to any state, or group of farmers, or body corporate, subject to the state, or group of states, or state institutions guaranteeing repayment of the loan.

(b) To grant direct loans to individual farmers, cooperative societies or other bodies (corporate or unincorporate) in appropriate cases, provided that the bank is satisfied that the schemes for which the loans are requested are viable and there is adequate security to cover such loans.

(c) To charge interest on loans to meet the full costs of management including debt servicing, allowing adequate sums to be set aside for general and bad debts reserves before paying any dividend..."

7. The Federal Government requested UNDP to assist in financing a project to organize and manage NAB during its first three years. The Bank is the executing agency for this project, and Berenschot-Bosboom NV, Tilburg, the Netherlands, are the consultants. The consultants are required to:

(a) assist the Board of Directors in formulating policy;

(b) with the approval of the Board of Directors, advise and assist State Governments and institutions on formulating credit policies and programs and organize and administer such policies;

(c) plan and implement an effective loan appraisal and evaluation system based on farm plans, and an effective data collection system;

(d) arrange for identification and preparation of agricultural development projects;

(e) arrange for the supervision of loans and to evaluate the economic results of said loans; and

(f) set up a suitable accounting system, manage the bank, train Nigerian staff for takeover of the bank, collect relevant data, etc.

8. NAB has a Board of Directors appointed by the Federal Government. The senior executive is the General Manager who has under him the following departments:

(a) Projects and Consultancy;

(b) Operations; and

(c) Administration and Finance.

9. During NAB's first year, the management concentrated on recruiting senior Nigerian staff and formulating NAB's operations, policies and procedures. Lending operations are now getting underway and up to September 1974 NAB's Board had approved loans up to ₦ 20 million (US$30 million) and had under consideration applications totalling ₦ 24 million (US$36 million).

10. The Federal Government has made available to NAB up to September 1974 ₦ 12 million (US$18 million) of which ₦ 1 million in the form of equity and ₦ 11 million with form of loans and had committed itself to provide additional funds to NAB totalling ₦ 14 million (US$21 million) of which ₦ 1 million would be in the form of equity and ₦ 13 million in the form of loan. The long-term plans and policies for NAB are still the subject of review. The decisions to be taken include: the pace and scale of future expansion; the extent to which NAB will work through State credit institutions and the extent to which it will involve itself directly in lending to large numbers of small farmers; and the arrangements for providing it with further Federal finance.

11. Nigerian Institute for Oil Palm Research (NIFOR). Financed since April 1972 by the Federal Government and prior to that by the Federal Government, State Governments and the Marketing Boards, NIFOR aims at the development of improved high yielding planting material, effective methods of crop husbandry and plant protection, and also the development of efficient extraction and quality control in large and small-scale processing. There are six research divisions; namely, Agronomy, Plant Breeding, Physiology, Pathology,

Statistics, and Chemistry (Soils, Nutrition and Processing). The institute maintains a 1,735 ha main station, twenty miles north of Benin City and also operates a sub-station at Abak in South East State.

12. Seed production at NIFOR is now being reorganized in a Plant Production Division under experienced management. At peak requirement in 1977 NIFOR will be able to supply the seed requirements of the projects (see Supplement 1, Appendix 5). The Institute is also in a position to assist the projects in the spheres of leaf and soil analysis.

13. In addition to providing the planting material and other technical services, the technical training of project field staff would be carried out at NIFOR (see Supplement 11) and a provision for this has been included in project costs (see appraisal reports).

14. The Nigerian Produce Marketing Company (NPMC) was created by the State Marketing Boards to act as their export sales agent. NPMC collected sale proceeds, paid export duties, port, shipping and handling charges and remitted the balance of the proceeds less its operating and handling charges to the respective Marketing Boards. NPMC has several produce departments (cotton, oil palm products, groundnuts, and cocoa) and owns the Bulk Oil Company which handles palm oil. NPMC's administrative expenses have been increasing and together with a declining volume of business have resulted in high overhead costs per ton of produce handled.

15. In early 1973 the Federal Government announced measures to reform the export commodity marketing and price fixing systems. Major objectives of these reforms are to:

(a) improve efficiency of commodity marketing;

(b) increase producers income as a means to generate greater incentives for agricultural production.

For further details see Supplement 12.

NIGERIA

OIL PALM PROJECTS

Federal Department of Agriculture

Monitoring and Evaluation Unit (MEU)

General

1. Under the Federal Department of Agriculture (FDA) which is a department of the Federal Ministry of Agriculture and Natural Resources (FMANR), a Monitoring and Evaluation Unit (MEU) would be established, because of the urgent need to strengthen the Ministry's capability of monitoring and evaluating the extensive agricultural development programs that are being planned. The MEU would be primarily concerned with:

(a) the financial and technical monitoring of on-going projects;

(b) evaluating their financial, economic, and socio-economic impact; and

(c) providing assistance in the planning and preparation of future development programs.

2. The main three crops involved are cocoa, oil palm, and rubber and Benin in the Mid-Western State would be a suitable base for staff concerned with monitoring these projects. FDA would be the executing agency and within one year of the commencement of the projects a team of specialists would be recruited to form the Tree Crop Section of the Monitoring and Evaluation Division (MED).

3. In consultation with the Tree Crop Section (TCU) in the Mid-Western State, and the Smallholder Management Units (SMU's) in the Western and East-Central States, and the Federal research institutions, such as the Nigerian Institute for Oil Palm Research (NIFOR), the Cocoa Research Institute of Nigeria (CRIN), the Rubber Research Institute of Nigeria (RRIN), the Tree Crop Section of MEU would be responsible for specifying the planting techniques and standards to be adopted in project implementation.

4. Continuous evaluation of the economic and socio-economic impact of the projects would be carried out in conjunction with institutions such as the Nigerian Institute for Social and Economic Research (NISER) as well as appropriate faculties of the universities.

5. In addition to monitoring and evaluating progress in projects, the Tree Crop Section of MEU would also be concerned with the planning and preparation of future development programs that involve Federal financing.

Having a Federal orientation, tree crop development planning would be rationalized on an "industry" basis as opposed to the present individual State approach. To cover specific fields of activity such as research, business management, processing engineering and project preparation, consultants would be called in from time to time. The Tree Crop Section of MEU would prepare progress reports for submission to Federal and State Governments, and where appropriate external financing agencies.

Financial/Technical Inspection

6. The financial control systems being used in projects would be examined at regular intervals (at least twice a year) with particular attention being given to the timing and procedures used in procurement; disbursement control; grant/credit accounting; produce price formulation and the control of credit repayment. Technical evaluation would concentrate on assessing the standards being attained in (i) field planting, maintenance and harvesting/tapping, and (ii) produce collection and central processing -- where applicable, for example in rubber and oil palm. This would involve very experienced staff making regular visits to the field and selecting specific areas for inspection -- not leaving it to project staff to decide where and what should be inspected. Field inspections should ensure a good coverage of nurseries and a cross-section of areas that were in (a) the first year of planting, (b) immature maintenance, and (c) mature maintenance and harvesting/tapping. In order to facilitate objective evaluation it will be necessary to establish an agreed system for quantitative assessment of work standards in relation to the main field practices. Inspection and field supervisory staff must apply the same criteria when making quantitative assessments if the analysis of inspection data and the recommendations arising there from are to serve as an effective instrument of management. For example, when assessing work standards for circle weeding oil palms, field observations should relate to the following:

(a) size of circles in relation to age;

(b) cleanliness of circles;

(c) damage to root systems;

(d) saucer depressions.

For each of these factors, the number of observations where work items had not been completed to the specified standards would be recorded and expressed as a percentage of the total number of circles in the inspection samples. Necessary corrective action should be taken either to remedy a fault, or ensure it is not repeated in subsequent rounds.

Project Evaluation

7. The broad objectives would be to evaluate the effectiveness and efficiency of project activities particularly in relation to their economic and socio-economic impact in the rural areas. In addition to measuring the financial/economic benefits accruing to the participating farmers and

companies, assessments would be made of such items as changes in employment levels, business activity, consumption patterns, participation in education and other economic and socio-economic indicators of community well-being.

8. Though the Tree Crop Section of MEU would be ultimately responsible for this work it would need to rely heavily on specialists from NISER, the universities and in certain instances expatriate consultants. Some of the data needed for analyses would be generated by project records and inspection reports. Other data would need to be collected by surveys and from secondary sources outside the project. It is envisaged that field enumeration would involve both project field staff and resource personnel such as university and college students.

Planning and Preparation of Future Development Programs

9. The Tree Crop Section of MEU would assist in the planning and preparation of future development programs by providing the executing agencies such as the Tree Crop Unit (TCU), Smallholder Management Units (SMU's), Oil Palm Companies, and Agricultural Development Authority with the basic support services required. Such services would take the form of:

(i) providing detailed guidelines for project preparation highlighting any problem areas requiring particular emphasis and making positive recommendations as to how such issues should be tackled;

(ii) liaising with TCU, SMU's State and Federal Government agencies ensuring that any services required from other institutions are made available for project preparation. For example, soil and land use surveys, main and feeder road development plans, future emphasis in education programs, etc.; and

(iii) attending Steering Committee and Board Meetings a representative of the Tree Crop Section of MEU would from time to time attend meetings of the Steering Committee of TCU and SMU's and also the Boards of the Oil Palm Companies as an observer.

Staffing

10. The specialist staff required to monitor and evaluate the tree crop projects would need to be very experienced and in the early years of establishing the Tree Crop Section of MEU in Benin it is envisaged that about a third of them would be recruited internationally.

Profession	Functions	Expatriate	Nigerian
3 Financial Analysts	financial/credit control	1	2
8 Agriculturalists	technical appraisal of planting/research	3	5
2 Engineers	appraising oil mill/rubber factory operations	1	1
5 Economists /1	evaluation, program preparation	1	4

/1 Including specialists from NISER and universities.

The agriculturalists should be men with 8 to 10 years' experience at senior management level in large scale oil palm, rubber or cocoa operations. Similarly the expatriate financial analyst and economist should have extensive experience - at least 5 - 7 years - of financial control, project preparation, appraisal and evaluation. To attract the highly experienced people needed for this type of work, appropriate contract and salary terms will need to be offered. The Nigerian professional staff would receive specialist training either in neighboring West African countries or, in some instances, in countries like Malaysia.

From time to time consultants would be engaged to:

(a) carry out specific studies such as, preparation of the design and tender specifications for processing systems; reviewing the work programs being carried out by the crop research institutes; reviewing the financial control systems being operated by projects;

(b) provide support staff for the preparation of future development programs.

Training

11. The Nigerian financial specialists would be given the opportunity to gain experience of the financial control systems being applied by large-scale nucleus estates with smallholder outgrowers and individual smallholder replanting/new planting schemes. Arrangements would be made to attach staff for periods of a month or so to organizations such as Sodepalm in the Ivory Coast, Camdev in the Cameroons, and the Rubber Industry Smallholder Development Authority in Malaysia. The agriculturalists would also need specialized training in the planting techniques and the organization and control of field practices for the main tree crops involved. For oil palm and rubber the Ivory Coast, Cameroon and Malaysia would be the most appropriate countries

to visit. For cocoa, Nigeria would be able to provide the sources for training. Arrangements would be made to attach staff to public or private sector research establishments, large-scale estates, and organizations specializing in smallholder replanting and new planting schemes. In view of the wide spectrum of technology and organizational control involved, staff would need to be attached to appropriate institutions for periods ranging from 3 to 4 months each. The economists would need to be trained in project evaluation, preparation and appraisal techniques, and NISER and the Economic Development Institute of the Bank Group would be suitable institutions for providing such training.

Financing

12. The Tree Crop Section of the MEU would be financed wholly by the FMG. During the period 1975 through 1983 expenditures are estimated to amount to ₦ 5.52 million (US$8.39 million) including ₦ 1.85 million (US$2.81 million) for contingencies. The foreign exchange component is estimated at about ₦ 1.81 million (US$2.74 million) or 33% of total costs. It is proposed that the Bank finance ₦ 2.76 million (US$4.20 million) or 50% of the cost for the period 1975 through 1983 (for details see Table 1).

13. Expenditures are estimated at ₦ 5.52 million (US$8.39 million) for a nine-year period. Average annual expenditures amount to ₦ 0.61 million (US$0.93 million). The Tree Crop Section of MEU covers projects in oil palm, rubber and cocoa and it is estimated that 50% of its costs could be charged to the oil palm projects (or ₦ 0.31 million, US$0.47 million). Three oil palm projects have been appraised in Western, Mid-Western, and East Central States and consequently the average annual costs of the Tree Crop Section of MEU for each project would be about ₦ 100,000 (US$152,000).

NIGERIA

OIL PALM PROJECTS

Federal Department of Agriculture - Monitoring and Evaluation Unit/Tree Crop Section, Benin

(Naira '000)

	Unit Costs (Naira)	1975	1976	1977	1978	1979	1980	1981	1982	1983	Total 1975-1983	Foreign Exchange %	1984 onwards
CAPITAL EXPENDITURE													
Building (10 N/sq ft)		75.0									75.0	30	
Office Equipment		18.0	9.5								27.5	40	
Vehicles (station wagons)	4,000	(6) 24.0			(6) 24.0			24.0			72.0	60	8.0 /1
Total		117.0	9.5		24.0			24.0			174.5		8.0
Personnel Costs													
Nigerian Staff													
Specialists /2	10,000	(6) 60.0	(12) 120.0	(12) 120.0	(12) 120.0	(12) 120.0	(12) 120.0	(12) 120.0	(12) 120.0	(12) 120.0	1,020.0	10	(12) 120.0
Administrative Officer	3,000	(1) 3.0	(1) 3.0	(1) 3.0	(1) 3.0	(1) 3.0	(1) 3.0	(1) 3.0	(1) 3.0	(1) 3.0	27.0	10	(1) 3.0
Secreteries	2,100	(6) 12.6	(6) 12.0	(6) 12.0	(6) 12.6	(6) 12.6	(6) 12.6	(6) 12.6	(6) 12.6	(6) 12.6	113.4	10	(6) 12.6
Clerks	750	(6) 4.5	(6) 4.5	(6) 4.5	(6) 4.5	(6) 4.5	(6) 4.5	(6) 4.5	(6) 4.5	(6) 4.5	40.5		(6) 4.5
Typists	750	(4) 3.0	(4) 3.0	(4) 3.0	(4) 3.0	(4) 3.0	(4) 3.0	(4) 3.0	(4) 3.0	(4) 3.0	27.5		(4) 3.0
Messengers	490	(1) .5	(1) .5	(1) .5	(1) .5	(1) .5	(1) .5	(1) .5	(1) .5	(1) .5	4.5		(1) .5
Watchmen	460	(3) 1.4	(3) 1.4	(3) 1.4	(3) 1.4	(3) 1.4	(3) 1.4	(3) 1.4	(3) 1.4	(3) 1.4	12.6		(3) 1.4
Drivers /3	640	(7) 4.5	(7) 4.5	(7) 4.5	(7) 4.5	(7) 4.5	(7) 4.5	(7) 4.5	(7) 4.5	(7) 4.5	40.5		(7) 4.5
Total		89.5	149.5	149.5	149.5	149.5	149.5	149.5	149.5	149.5	1,285.5		149.5
Expatriate staff/Consultants Services													
Specialists	35,000	(6) 210.0	(6) 210.0	(6) 210.0	(4) 140.0	(4) 140.0	(3) 105.0	(3) 105.0	-	-	1,120.0	50	-
Consultants Services /4	5,000	-	(4) 20.0	(6) 30.0	(8) 40.0	(8) 40.0	(8) 40.0	(8) 40.0	(8) 40.0	(8) 40.0	290.0	100	(8) 40.0
Total		210.0	230.0	240.0	180.0	180.0	145.0	145.0	40.0	40.0	1,410.0		40.0
Operating Cost													
Office services		3.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	51.0	60	6.0
Office repair and maintenance		-	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	24.0	60	3.0
Vehicle running costs	1,000	(6) 6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	54.0	40	6.0
Travel subsistence /5	3,400	(9) 30.6	(15) 51.0	(15) 51.0	(13) 44.2	(16) 54.4	(15) 51.0	(15) 51.0	(12) 40.8	(12) 40.8	414.4		(12) 40.8
Training /6		25.0	25.0	25.0	25.0	-	-	-	-	-	100.0	100	-
Surveys /7		-	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	160.0		-
Total		64.6	111.0	111.0	104.2	89.4	86.0	86.0	75.8	75.8	803.8		55.8
TOTAL		481.1	500.0	500.5	457.7	418.9	380.5	404.5	265.3	265.3	3,673.8	33	253.3
of which local costs		(295.2)	(326.6)	(320.9)	(288.7)	(289.3)	(268.4)	(278.0)	(205.3)	(205.3)	(2,477.7)		(187.1)
foreign exchange costs		(185.9)	(173.4)	(179.6)	(169.0)	(129.6)	(112.1)	(126.5)	(60.0)	(60.0)	(1,196.1)		(66.2)
Physical Contingency (5%)		24.1	25.0	25.0	22.9	20.9	19.0	20.2	13.3	13.3	183.7	33	12.7
Price Contingencies /8		72.2	101.0	141.9	177.0	197.9	219.7	285.9	217.3	250.7	1,663.6	33	-
GRAND TOTAL		577.4	626.0	667.4	657.6	637.7	619.2	710.6	495.9	529.3	5,521.1	33	266.0

1/ Six depreciated over 3 years, is average of 2 each year.
2/ Includes head of office.
3/ One for each car and reserve driver.
4/ N 5,000 per consultant man-month.
5/ N 3,400 per annum for each senior staff member (Nigerian and expatriate specialists) at the office (not in training).
6/ Three Nigerian staff members each in the first four years; assumed 2 for a whole year; 1 for a half year.
7/ Assumed 3 field surveys each year and for each survey are required about 30 men for 4 weeks and computer time.
8/ 18/15/12% compounded range for buildings; 14/11/7.5% compounded range for office equipment and vehicles; 7% compounded for personnel and operating costs. Price contingencies calculated from 1974 onwards over base costs and physical contingencies.

NIGERIA

OIL PALM PROJECTS

A Comparison between Small and Large-Scale Palm Oil Mills

General

1. The fruits produced from the project's smallholdings could be processed at small mills using hand hydraulic presses or at large fully integrated central mills. The small-scale units would involve low capital investment but high operating costs coupled with lower oil extraction rates and poor oil quality in terms of free fatty acid (ffa) content and keeping properties. The large central mills would apply advanced technology involving higher capital expenditure and well qualified engineers. However, these large mills would have economies of scale, lower unit production costs, higher oil extraction rates and better oil quality.

2. In the following sections existing palm oil extraction systems are compared from the standpoint of:

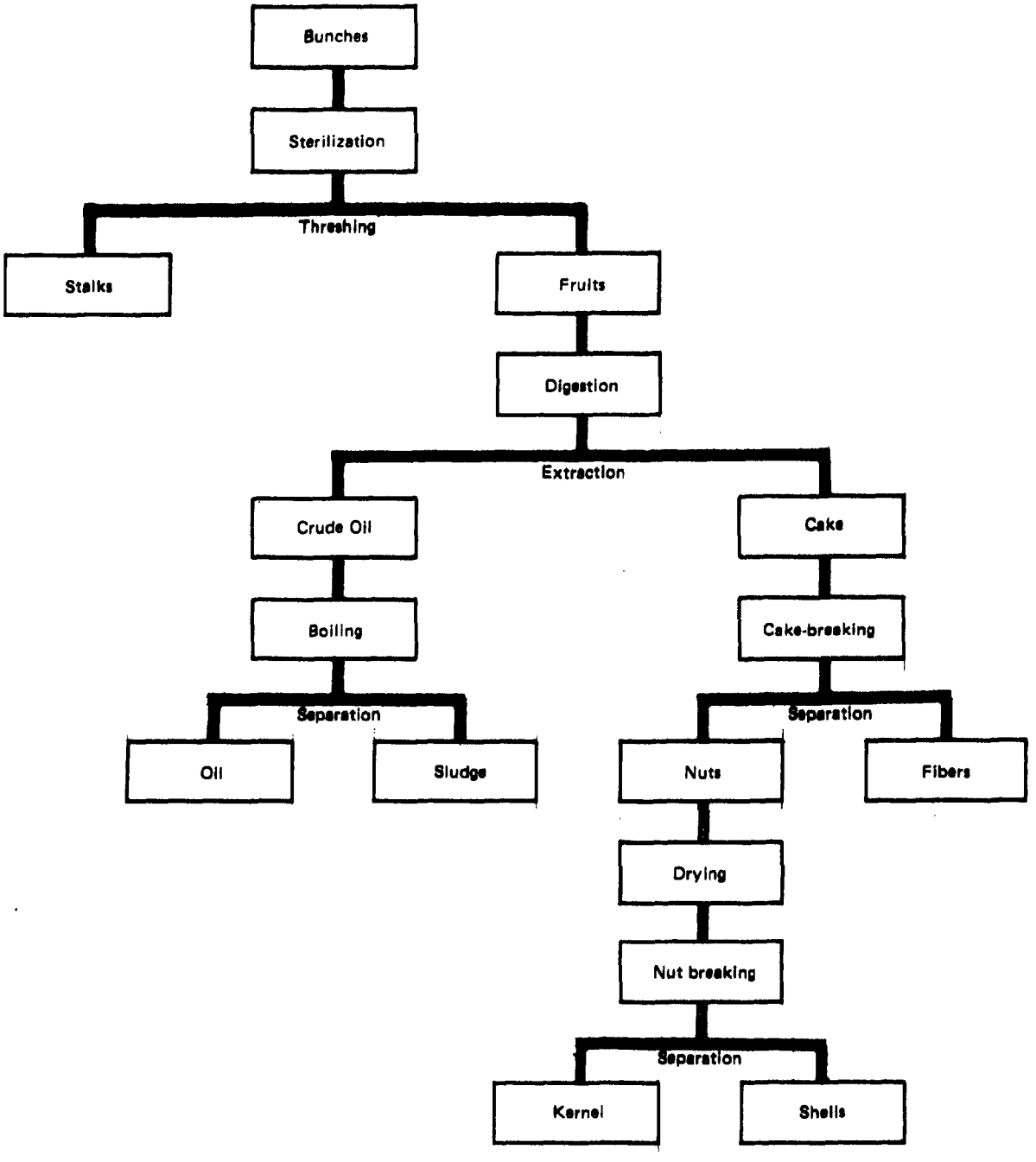
(i) the investment and operating costs for varying sizes and types of processing equipment;

(ii) processing costs and returns per ton of fresh fruit bunches (ffb) processed in mills of different types and sizes; and

(iii) economic returns to investment using small and large-scale mills.

A. Comparison of investment and operating costs for varying types and sizes of equipment

3. The processing of palm oil fruit bunches is essentially a succession of physical separations that can be schematized as follows:



World Bank—8820

4. The final efficiency in relation to the extraction of oil and kernels from the bunches is a function of the efficiency of the separations from which they derive; consequently, each of them is of equal importance. The efficiency at any stage of separation is primarily conditioned by the equipment used. However, when selecting the equipment, a compromise has to be made between its cost and efficiency.

5. In general, for a given level of extraction efficiency the cost per unit of fruit processed decreases as the capacity of the equipment used increases. Furthermore, as the size of mill increases the operating and management costs do not increase in direct proportion. The cost of processing equipment can be reduced but only by lowering extraction efficiency levels and sometimes the quality of the products, and raising operating costs per unit of throughput.

6. The following sections examine the effect of the volume of throughput on:

(a) the type of equipment used;

(b) the cost of such equipment;

(c) its extraction efficiency;

(d) the quality of the products; and

(e) the operating expenses.

7. It is assumed that the fruit to be processed is Tenera, as this is the material to be planted in the projects. Dura fruit from wild palm groves requires somewhat different processing equipment, particularly in relation to the use of continuous screw presses for oil extraction.

Sterilization

8. Sterilization prepares the bunches for separating the fruits from their stalks. It must be emphasized that the sterilization process affects the efficiency levels attained at all subsequent separation stages, as well as the quality of the final products - essentially the acidity of oil and the color of the kernels.

9. During sterilization the bunches are treated with steam or boiling water in order to weaken both the connecting tissues attaching the fruits to the stalks and the walls of the oil cells in the mesocarp. Simultaneously, the enzymes that build-up the free fatty acids in damaged fruit are destroyed. If sterilization is carried out using steam at sufficiently high pressure (2.2 to 3 kg per cm^2), part of the kernels become loosened in the shells making subsequent separation easier.

10. Mills with an ffb capacity of 6 tons/hr and over. For efficient sterilization and ease of fruit handling, it is now standard practice to install horizontal sterilizers using steam under a pressure of 3 kgs/cm^2. The bunches are loaded into perforated sterilizer cages that have a capacity of 1.5 or 2.5 tons. Trains of 3 to 8 cages are rolled into the sterilizer where they are treated with steam at a pressure of 2.2 to 3.0 kg/cm^2. Steam consumption is very high at the beginning of the operation and to reduce the peak requirements for steam to levels compatible with boiler capacities, it is necessary to distribute the load by installing at least two sterilizers. The trains of sterilizer cages are normally handled by electric winches or locomotives.

11. These horizontal sterilizers have to resist steam under medium pressure and need to be fitted with steam-tight doors that have a diameter of 1.70 m or 2.05 m depending on the size of cage being used. The door, the dome-shaped end, the operating and control fittings are the most expensive part of a sterilizer; consequently, for the larger mills, sterilizers are built as long as possible but compatible with peak boiler capacity and the manouvering of the trains. In practice, sterilizers tend to be confined to capacities of twenty tons of ffb (8 cages of 2.5 tons each).

12. The cost of sterilizing equipment per ton/hr capacity decreases with the size of the installation. On the basis of current prices, it is estimated that if the cost index for a sterilizer unit capable of handling 6 ton/hr was 600 (using 1.5 ton cages) a 20-ton per hour unit would have a cost index of 1040 (using 2.5 ton cages). Expressed in terms of ton/hr capacity, these cost indices would be 100 and 52 respectively.

13. Mills with an ffb capacity of less than 6 tons/hr. In the past, vertical sterilizers with manual unloading have been widely used in mills of this capacity range. With these sterilizers unloading is slow and heavy on labor and loss of oil in the stalks is high. For these reasons, the current trend is to use vertical sterilizers with removable perforated fruit containers that hold 1.5 tons. These containers are loaded into the sterilizer by electric hoist, which at the end of sterilization unloads and empties them into the threshing unit.

14. Equipment capable of sterilizing 1.5 tons of fruit per hour costs about 75% of the 6 ton/hr horizontal sterilizer unit mentioned earlier. The cost of a 3-ton/hr vertical unit would, however, be the same as a 6 ton/hr horizontal unit. The main reason for the relatively high costs is that the steam-tight doors and dome-shaped ends of the vertical sterilizers are the same size as those used in horizontal sterilizers.

15. The vertical sterilizers, however, need much less floor space than the horizontal units, which require shunting area for the fruit cages. Below 6 ton/hr capacity, savings in civil works and building costs compensate for the higher cost of equipment and the vertical sterilizer system tends to be cheaper.

16. Mills with an ffb capacity of less than 1.5 tons/hr. In the case of mills with a small throughput, the installation of a conventional sterilizing unit is frequently considered too expensive. As an alternative, boiling water or steam at atmospheric pressure is used for sterilization. Under these conditions, the sterilizing equipment does not have to be capable of resisting high pressure nor does it require steam-tight doors. The most simple sterilizing unit would comprise a metal container for the fruit bunches and the boiling water heated by an open fire.

17. With an operating temperature of 100 °C as compared with pressurized steam at 135 to 145 °C, the transmission of heat through the bunches is slower and hence the time required for sterilization has to be extended. In order to accelerate heat penetration, the bunches are usually quartered, but this leads to fruit damage, the build-up of ffa and oil losses. Even with bunch quartering, the time required for sterilization is much longer than when pressurized steam is used. In practice, the time required to complete the operation may be up to 5 times that needed when using pressurized steam. This means that the container capacity required may be up to five times that of a conventional sterilizer. In addition, the low efficiency of the open fire means that fuel consumption is high. Furthermore, the lack of precision inherent in this system leads to uneven performance. In view of this, sterilization with pressurized steam is recommended even for processing systems involving 0.5 to 1.5 tons per hours.

18. The following table gives indices of the investment and operating costs for varying sizes and types of sterilizing units:

Unit Capacity (tons of ffb/hr)	Type of Unit	Relative Equipment Costs /3	Index of Equipment Cost per ton of ffb per hour	Index of Operating Cost per ton of ffb per hour
0.8	Vertical /1	80	100	625
1.5	Vertical /2	450	300	200
3.0	Vertical /2	600	200	135
6.0	Horizontal	600	100	100
10.0	Horizontal	670	67	60
20.0	Horizontal	1,040	52	35
40.0 (2x20)	Horizontal	2,080	52	35

/1 Manual loading and unloading.
/2 Movable container with crane hoist.
/3 Indices of equipment costs based on 1973 quotations.

Threshing

19. Threshing is the separation of fruits from their stalks. A measure of the efficiency of this operation is the extent to which the fruits are removed from the bunches with a minimum loss of oil in the stalks.

20. Mills with an ffb capacity of 1.5 tons/hr or over. Mills of this capacity would normally use the "squirrel cage" thresher. This cage rotates at a speed that creates a peripheral centrifugal force that is slightly lower than gravity. Consequently, the bunches in the rotating cage drop just prior to reaching the top of the cage and the impact loosens some of the fruits which drop between the bars of the cage. This process is repeated until all fruits have been removed from the bunch.

21. Based on experience, a suitable cage diameter which gives the desired intensity of impact to loosen fruit appears to be between 1.70 m and 2.1 m. The length of the cage is a function of the number of impacts needed to loosen all the fruit and the quantity of bunches to be processed per hour. In practice, it has been found that a suitable length ranges between 3 to 5 m. The smaller cages are used for throughputs ranging from 1.5 to 3 tons per hour; the larger cages being capable of processing up to 30 tons of bunches per hours.

22. The cost of these threshing cages does not vary in direct proportion to their capacities. A unit measuring 1.7 m diameter and 3 m in length that can process up to 3 tons/hr would cost about 60% of a cage with a 2 m diameter and 4 m in length capable of handling up to 20 tons per hour.

23. Mills with an ffb capacity of 1.5 to 0.8 tons/hr. A "rotating arms" thresher would be used. These machines though relatively inexpensive are hand loaded and operating costs are comparatively high. In addition, oil losses in the stalks are high.

24. The following table gives indices of the investment and operating costs for varying sizes of threshing units.

Unit Capacity (tons of ffb/hr)	Relative Equipment Costs /1	Index of Equipment Cost per ton of ffb per hour	Index of Operating Cost per ton of ffb per hour
1.5	150	100	400 /2
3.0	500	170	200 /2
6.0	600	100	100 /2
10.0	820	82	60 /2
20.0	1,000	50	30 /3

/1 Indices of equipment costs based on 1973 quotations.

/2 Manual loading with 1 laborer per machine.

/3 Mechanical loading.

Digesting

25. This involves the preparation of fruit for oil extraction. Fruits are kneaded at high temperature (about 100°C) to break the oil containing cells. The walls of these cells should have been weakened during sterilization and hence the results obtained in digesting will be partly dependent on the efficiency of the first operation.

26. Digesting takes place in a cylindrical mixing machine fitted with a slowly rotating shaft which has specially shaped arms. Steam is injected into the base of the digestor to raise the temperature of the fruit mash to 100°C. Fruits are fed into the top of the digestor and the heated mash drawn off through a sliding panel in the lower section. In practice, results obtained with small digestors compare satisfactorily with large digestors, providing the period allowed for digestion is sufficient (approximately 30 minutes). Hence, the size of the digestor must be geared to the throughput.

27. The largest digestors currently in use are about 3 m high with a diameter of 1.2 m and a capacity of 10 to 12 tons of ffb per hr, which in turn corresponds to the throughput of a continuous screw press.

28. The cost of a large digestor capable of handling the fruits of 10 to 12 tons of ffb per hour is about 3 times that of a machine capable of digesting the fruits of 1.5 tons of ffb an hour; in terms of cost per unit of throughput (tons of ffb per hr), the small digestor being about 2.5 times more expensive than the large unit.

Extraction

29. This involves the separation of the crude oil from the mash by either a "wet" or a "dry" process.

30. In practice, the wet process is only used for small scale units with a ffb throughput of less than 1 ton/hr. In this process the digestor has a perforated base plate and during the early stages of digestion some oil and oil containing cells flow through the holes. After a few minutes, boiling water is sprayed over the fruits so as to wash the mash, thus removing the bulk of the oil and oil containing cells. At the end of the process the washed fibers and nuts are discharged through a door at the lower end of the digestor which is refilled with fruits.

31. The dry process is the method of oil extraction most extensively used. Essentially, this process involves loading the mash from the digestor into a perforated cage and subjecting it to high pressure in order to expell the crude oil (oil, water and oil containing cells). The efficiency of this separation process is a function of a combination of the degree of pressure, the period of time for which it is applied and the temperature, which should be as close to 100°C as possible so as to reduce the viscosity of the oil and facilitate its flow.

32. The continuous screw press produces pressures that are at least double those attained by the hydraulic press, which is subject to mechanical strength limitations and sealing problems. Additional advantages of the screw press result from its low requirements for labor, spare parts and maintenance. The continuous screw press is basically designed for throughputs ranging from 3 to 12 tons of ffb per hour. However, it must be pointed out that with the continuous screw press an efficient separation of clarified oil from the crude oil involves the use of elaborate and expensive clarification equipment. Therefore, for throughputs of less than 3 tons of ffb per hour the hydraulic press, which requires less sophisticated and cheaper clarification equipment, is preferred.

33. The following table gives indices of the investment and operating costs for presses of varying types and sizes:

Unit Capacity (tons of ffb/hr)	Type	Relative Equipment Cost /1	Index of Equipment Cost per ton of ffb/hr	Index of Operating Cost per ton of ffb/hr	Normal Oil Loss in Fibres (%)
0.5	Hand Hydraulic	160	320	4,800 /2	10.0
0.5	Motorized Hydraulic	175	350	2,400	10.0
3.0	Continuous Screw	750	250	400	6.0
6.0	Continuous Screw	750	125	200	6.0
12.0	Continuous Screw	1,000	83	100	6.0

/1 Indices of equipment cost based on 1973 quotations.
/2 A hand hydraulic press operated manually involves double the labor of motorized hand hydraulic press.

Clarification

34. The crude oil produced at the extraction stage contains a mixture of oil, water and cell tissue and the objective of clarification is to separate the oil from the other components. The oil and the cell tissue have specific gravities that are very similar and therefore, complete separation by settlement is not possible. However, approximately 50% of cell tissue can be dissolved in boiling water, thus releasing any oil that was adhering to this tissue. Hence, the first stage in clarification involves separating the fraction of the crude oil containing the cell tissue and boiling it. To recover the oil from the undissolved cell tissue necessitates the use of large high speed centrifuges.

35. In both the "wet process" and continuous screw press the crude oil contains a high proportion of cell tissue. On the other hand, due to lower pressure exerted during extraction the crude oil produced by hydraulic presses has a relatively low cell tissue content.

36. As pointed out earlier, the wet process is only used for units with a throughput of less than 1 ton of ffb per hour. However, the smallest centrifuge capable of giving a satisfactory separation efficiency has a capacity which corresponds to 3 tons of ffb per hour. In practice, such a machine is considered to be too expensive for a unit with a throughput of less than 1 ton/hr. Therefore, with a small scale wet process unit, the oil adhering to the 50% undissolved cell tissue cannot be recovered.

37. When using hydraulic presses for throughputs of less than 3 tons of ffb per hour, the percentage of cell tissue in the crude oil is low. In view of this, it is difficult to justify the installation of an expensive centrifuge for recovering the oil adhering to the 50% of cell tissue that is insoluble in boiling water.

38. The following table gives indices of the investment and operating costs of clarification units for varying throughputs and type of extraction equipment:

Unit Capacity (tons ffb/hr)	Type of Extraction	Relative Equipment Cost /1	Index of Equipment Cost per ton of ffb/hr	Index of Operating Cost per ton of ffb/hr	Approximate Efficiency %
0.8	Wet Process	48	60	1,250	70-80
1.5	Hydraulic Press	293	195	670	93
3.0	Continuous Screw	540	180	340	95
6.0	" "	930	155	170	95
12.0	" "	1,000	120	170	97
20.0	" "	2,000	100	100	97

/1 Equipment costs include all the tanks, filters, vibrating screens, pumps, piping and fittings.

Separation of Fibers and Nuts

39. For mills with a throughput of 1.5 tons of ffb/hr or over, even small amounts of fibers on the nuts are sufficient to cause them to conglomerate and prevent their even flow through the drying silos and, therefore, all fibers must be removed prior to drying.

40. In the dry process mills, the cake residue from the extraction process is broken and then exposed to a vertically ascending current of air moving at a speed that carries the loose fibers up to the boiler room and allows the nuts to drop into a rotating polishing drum.

41. For throughputs of less than 1.5 tons of ffb per hour using the dry or wet process, the nuts are usually sorted by hand and invariably some are lost in the fibers.

42. The following table gives indices of the investment and operating costs of fiber and nut separators for varying throughputs:

Unit Capacity (tons ffb/hr)	Relative Equipment Cost	Index of Equipment Cost per ton of ffb/hr	Index of Operating Cost per ton of ffb/hr	Efficiency %
0.8	-	-	3,130 /1	85-90
1.5	420	280	280 /2	97
6.0	900	150	150 /2	97
12.0	1,220	102	102 /2	97
20.0	2,000	100	100 /2	97

/1 Labor cost only.

/2 Cost of spare parts only.

Separation of the Kernels and the Shells

43. Separation of the kernels from the nuts is made in four successive steps:

1. Detaching the kernel from the internal wall of the shell;
2. Nut cracking, which involves breaking the shell without damaging the kernel;
3. Separating the lighter parts of shell fragments from the cracked mixture; and
4. Separating the kernels from the large shell fragments.

Detaching the Kernel from the Shell

44. This is done by drying during which the kernel shrinks and separates from the shell wall.

45. Mills with an ffb capacity of more than 1.5 tons/hr. The dryers used are vertical silos with a capacity of at least 20 hours of nut output. Warm air is blown into the upper and middle sections to dry the nuts; cool air is blown into the lower section to cool the nuts and make their shells brittle prior to cracking. The process is fully automatic with the nuts loaded at the top of the silo, which is kept continuously full. Nuts are extracted at the base by a device which ensures an even flow through the silo.

46. Mills with an ffb capacity of between 0.5 and 1.5 tons/hr. Silo-type dryers are too expensive for this level of throughput and drying is usually done by treating the nuts with steam under pressure. Steam pressure of about 3 kg per cm^2 is applied two or three times for a few minutes. Part of the water content of the kernels evaporates at each release of the steam pressure and drying then proceeds slowly for a few hours when the nuts are cooled prior to cracking. Though the results obtained with this drying system are good, the equipment is expensive and a certain amount of labor is required.

47. For mills with a throughput of less than 0.5 tons of ffb per hour, the nuts are sun-dried for a few days before cracking. Although no equipment is needed, the labor requirements are high and the drying tends to be uneven.

Nut Cracking

48. The objective in this process is to crack the nuts without damaging the kernels. Tenera nuts are, however, difficult to crack because although the shells are thin, one end is covered by a tuft of ligneous fibers that can deaden the impact of cracking. Good results can be obtained using large centrifugal crackers which throw the nuts against a steel wall that is a sufficient distance from the center to enable the nuts to be orientated so that the tufts are to the rear, thus ensuring that the unprotected surface of the shell strikes the wall. Centrifugal nut crackers for tenera nuts must have a minimum diameter of 1.20 m and hence have a large capacity.

49. With tenera nuts there tends to be a correlation between nut size and shell thickness, with small nuts having a thin shell. The energy required to break the shells will, therefore, be different for small as opposed to large nuts. Given this situation, to obtain good results the nuts should be sorted into two size groups and cracked in centrifuges that are running at different speeds.

50. For mills with a throughput of more than 12 tons of ffb per hour, in order to attain a high level of efficiency, the nut cracking station would need to be equipped with two centrifugal nut crackers; this equipment being capable of handling the nuts of a throughput of up to 30 tons of ffb per hour.

51. For mills with a throughput ranging from 1.5 to 12 tons of ffb per hour, in order to reduce investment cost a single nut cracker would usually be installed. However, some of the small kernels would be shattered and lost - thus reducing efficiency.

52. Mills with a throughput of less than 1.5 tons of ffb per hour are generally equipped with small nut crackers that are basically designed for dura nuts that are not tufted. These nut-crackers though inexpensive give poor results with tenera material and efficiency levels may drop to around 85%.

Separating the Lighter Part of the Shell Fragments from the Cracked Mixture

53. The kernels and the small pieces of shell with tufts of fibers have similar specific gravities and, therefore, cannot be separated by settlement. However, their shape, and therefore their resistance to a current of air, is markedly different. By exposing the cracked mixture to a vertical current of air, the small pieces of shell and tufts of fiber are carried up and to the boilers, whereas the kernels and the large fragments of shell drop down to the clay baths or hydrocyclones for subsequent separation.

54. Mills with a throughput of less than 1.5 tons of ffb per hour are usually not equipped with a light particles separator. This means that the light shell particles and the kernels have to be separated manually before bagging.

Separation of the Kernels from the Large Shell Fragments

55. For mills with a throughput of more than 6 tons of ffb per hour, separation is made using hydrocyclones. The results are good, no labor is needed but the energy consumption is high requiring an output of around 40 kilowatts.

56. Hydrocyclones are therefore used only in mills that are large enough (6 tons of ffb/hr and over) to have boilers and steam engines with an efficiency high enough to deliver this power using their own fiber and shell as fuel.

57. For mills with a throughput of less than 6 tons of ffb per hour, claybaths, which have a low energy consumption, are used for separating kernels and shells. The density of the clay suspension is such that the kernels float and the shells sink. The kernels are skimmed off, washed and then dried.

58. The claybath system involves considerable use of labor for the daily preparation of the clay suspension, which has to be continually tested and adjusted if necessary in order to ensure satisfactory separation.

Kernel Drying

59. To avoid deterioration in storage, the water content of kernels has to be reduced to about 7%. The dryer is essentially a vertical silo in which warm air is injected at several levels. When drying, the temperature of the kernels should not exceed 60°C in order to prevent oil losses. To achieve this, the drying process has to be gradual and usually takes about 10 hours. The kernels are fed into the top of the dryer and extracted at the base using a mechanism that ensures an even flow through the system.

60. For mills with a throughput of less than 1.5 tons of ffb per hour, kernels are generally sun-dried. Sun drying involves labor for spreading the kernels in thin layers and collecting each evening or in the event of rain.

61. The following table gives indices of the investment and operating costs of kernel extraction units for varying throughputs.

Unit Capacity (tons of ffb per hour)	Type of Equipment (see foot-notes)	Relative Cost of Equipment	Index of the Investment Cost per ton of ffb per hour	Index of Labor Cost per ton of ffb/hr	Average Efficiency %
0.8	/1	56	70	3,125	85
1.5	/2	735	490	670	92
6.0	/3	1,030	172	250	92
12.0	/4	1,512	126	125	92
20.0	/5	2,000	100	100	94

/1 Nuts steam treated; small nutcrackers, hand-operated claybath, kernels sun dried.

/2 Vertical nut dryer, one large nutcracker, light particles separator, automatic claybath, vertical kernel dryer.

/3 Similar to 2 but has larger nut and kernel dryers.

/4 Vertical nut dryer, one large nutcracker, light particles separator, hydrocyclones, vertical kernel dryer.

/5 Vertical nut dryer, two large nutcrackers, light particles separator, hydrocyclones, vertical kernel dryer.

B. Comparison of Processing Costs and Returns per ton of ffb processed in mills of different types and sizes

62. The production situation in terms of hectarage and location being known, the problem of determining the type of processing system best suited to the established production patterns becomes essentially a matter of assessing:

(a) the processing capacity required to handle the fruit produced;

(b) the capital expenditure involved in establishing the different processing systems;

(c) the management costs for these processing systems;

(d) the maintenance costs for the processing systems;

(e) the transport costs involved in bringing the fruit to the processing sites;

(f) the cost of any road improvements required to facilitate fruit collection; and

(g) the relative extraction efficiencies of the different processing systems.

Appendix 1 gives a comparison of processing costs (in 1973 terms) and returns per ton of ffb for different types and sizes of mills, given a production situation similar to that projected for the proposed smallholder project in the East Central State.

63. Assuming that at maturity the annual level of production reaches about 160,000 tons, the various processing systems examined are:

(i) a single central mill with a capacity of 40 tons/hour;

(ii) two mills with capacities of 30 and 10 tons/hour respectively;

(iii) two mills with capacities of 20 tons/hour each;

(iv) four mills with capacities of 10 tons/hour each;

(v) eight mills with capacities of 5/6 tons/hour each;

(vi) 60 rural oil palm kits with capacities of 0.8 tons/hour; and

(vii) 89 to 99 hydraulic hand presses with capacities of just under 0.5 tons/hour.

64. It is assumed that a two stage fruit collection system is used in the case of all continuous screw press mills. This fruit collection system essentially comprises using tractor/trailers to bring fruit bunches from the farm-gate to central collection points from where fruit is transported by truck to the mill sites. Assuming that the tractor/trailer costs remains unchanged for all the screw press systems, Table 1 through 5 in Appendix 2 show that as the number of mills increases the cost of truck transportation decreases--this being essentially due to the shorter haulages involved.

65. With the "oil palm kit" and "hand hydraulic press" systems, fruit collection is not costed as it is assumed that the bunches would be brought directly to the mills by the producers. Though not costed, in fact, a considerable amount of time and labor would be involved in bringing fruit to the small mills. It must also be emphasized that with a large number of small mills, the location of reliable water supplies could be a major constraint. In addition, waste disposal in heavily populated areas would be a serious problem.

66. Column 1 Appendix 1 quotes figures given by S. C. Nwanze in the Journal of West Africa Institute for Oil Palm Research (1965). Costs have been updated to 1973 levels but some cost items such as management and spare parts were not included and so total processing costs would be higher than those quoted.

67. Column 2 in Appendix 1 is based on results obtained in the Ilutitun mill (near Okitipupa, Western State) from January to October 1973. This mill has six Stork hydraulic hand presses, a mechanical digestor with sterilization in boiling water or steam at atmospheric pressure. A diesel driven alternator generates the power required by the digestor and nut-cracker.

68. The rural oil palm kit has a capacity of 0.8 tons of ffb/hour and uses the wet processes for oil extraction. The equipment includes two digestors that are driven by diesel engine, a nut-cracker, a hand operated claybath for separating kernels and shell fragments and a steam boiler for sterilization and the clarification of the crude oil.

69. The continuous screw press mills of capacities ranging from 6 to 40 tons of ffb/hour, are basically the same design, differing only in details such as the number of nut-crackers (1 for the 5/6 and 10/12 tons/hour mills with 2 for all other sizes). The kernel/shell fragment separators also differ (claybaths for the 5/6 tons/hour mill and hydrocyclones for all others).

70. From this analysis it is clear that there are considerable advantages accruing to the large-scale mills with returns per ton of ffb processed ranging from N 23.63 for the hydraulic hand press system to N 41.74 for the 40 ton/hour continuous screw press mill.

C. Economic Returns to Investment When Using Small and Large-Scale Mills

71. The economic costs and benefits of a scheme involving the planting of about 16,000 ha of smallholdings 1/ with high yielding material together with establishing a fully integrated fruit collection and central processing system are shown in Table 1, Appendix 4. With the same planting program, it might be argued that large numbers of small-scale hand hydraulic processing units are economically more "efficient" and therefore preferable to a fully integrated fruit collection and central processing system employing large-scale mills. The two systems are therefore compared.

Costs

72. For purposes of comparison all costs of field establishment, field maintenance, staff, headquarters and regional unit capital and recurrent expenditure remain unchanged. The road improvement program will be required for both systems being compared, as substantial quantities of oil will have to be assembled from the large number of small processing units for distribution to the large urban markets. On the assumption that transport costs per ton of oil are the same as the transport costs per ton of ffb and assuming that the hand hydraulic presses extract 19% oil to bunch then the oil assembly costs in the area could be estimated at 19% of the fruit collection costs. However, with larger quantities of fruit than oil and a well coordinated fruit collection system, economies of scale would be expected in favor of fruit. For purposes of this comparison, therefore, it has been assumed that the assembly costs of oil from the small processing units, would be 25% of the fruit collection costs for large central mills. Costs for the development and processing of 16,000 ha of oil palm using small hand hydraulic mills are given in Table 2 Appendix 4.

Benefits

73. The large central mills are expected to achieve a 22% extraction rate from year 9 onwards 2/ and the project benefit stream is given in Table 1, Appendix 4. Two streams of benefits have been calculated for the hand hydraulic press systems applying oil to bunch extraction rates at full maturity (year 9 and onwards) of 16% and 19% respectively. 3/ (Table 2, Appendix 4.)

1/ This analysis is based on the actual East Central State Project.

2/ Year 0 is year of planting.

Extraction Rate (%): $\frac{4}{16}$ $\frac{5}{17}$ $\frac{6}{18}$ $\frac{7}{19}$ $\frac{8}{20}$ and $\frac{9 \text{ onwards}}{22}$

3/ The following extraction rates have been used:

Extraction Rate (%)	16	17	18	19	19	19
Extraction Rate (%)	16	16	16	16	16	16

Comparison of Economic Rates of Return

74. The rates of return for the small and large-scale processing systems are given in Table 3, Appendix 4. Even with the comparatively optimistic assumption (19% extraction) for the small unit, the large central mills system yields a higher rate of return. In practice extraction rates in excess of 16% are not likely to be achieved by small hand hydraulic mill operators. From Table 3, Appendix 4, it can be seen that the rate of return for large scale processing is 19.7% and for small scale processing 14.3% (assuming 19% extraction rate) or 11.2% (assuming 16% extraction rate). Table 3, Appendix 4 also gives a sensitivity analysis of these rates of returns. From these figures it becomes clear that the large central mills yield an economic rate of return 75% higher than that for the hand hydraulic press operating at a 16% extraction rate.

75. The foregoing financial and economic analyses demonstrate the advantages of large mills over small processing units both with respect to returns to investment and the prices that producers can be paid for their fruit. Where nucleus estates have cr are to be established, additional oil mill investment required to process outgrowers production is even lower than the figures used above, since all the infrastructure and the bulk of civil works will have been absorbed by the estates.

A Comparison of Processing Costs and Returns per Ton of ffb Processed for Different Mill Types and Sizes [1/]

Type of Mill	Hydraulic Hand Press Mill		Rural Oil Palm Kit	Continuous Screw Press Mills							
Capacity tons/hour	0.45	0.475	0.8	5 to 6	10 to 12	20	10	+	30	= 40	40
Number of Units required for total of 160,000 tons	89	99	60	8	4	2	1	+	1		1
Price per unit (N'000)	3.40	50	80	1,500	2,050	2,460	2,050		3,180	5,230	3,520
Total Investment (N'000)	302	4,950	4,800	12,000	8,200	4,920	2,050		3,180	5,230	3,520
Management Costs (N total)	N/A	-	-	191,060	165,072	93,786	41,268		46,893	88,161	46,893
Management Costs (N per ton)	N/A	1.480	1.526	1.194	1.031	0.586	-		-	0.551	0.293
Maintenance Cost (N total)	-	-	-	44,200	28,080	17,030	7,020		10,010	17,030	11,505
Maintenance Cost (N per ton ffb)	0.221	0.344	0.324	0.276	0.176	0.106	-		-	0.106	0.072
Operating Costs (N total)	-	-	-	175,200	87,600	50,834	21,920		29,722	51,642	43,157
Operating Costs (N per ton ffb)	7.742	8.220	3.253	1.095	0.548	0.318	-		-	0.323	0.270
Other Costs (N total)	-	-	-	72,000	44,000	26,000	11,000		15,000	26,000	17,000
Other Costs (N per ton ffb)	5.748	3.828	0.550	0.450	0.275	0.163	-		-	0.163	0.106
Spare Parts (N total)	-	-	-	192,000	118,669	77,006	29,779		51,318	81,097	62,092
Spare Parts (N per ton)	N/A	0.711	0.456	1.200	0.742	0.481	-		-	0.507	0.388
Processing Costs (N total)	-	-	-	674,460	443,421	264,656	110,987		152,943	263,930	180,697
Processing Costs per ton ffb (N per ton)	13.711	14.583	6.109	4.215	2.771	1.654	-		-	1.650	1.129
Depreciation (N per ton)	0.221	3.125	3.125	3.625	2.477	1.486	-		-	1.580	1.063
Total Processing Costs (N per ton)	13.932	17.708	9.234	7.840	5.248	3.140	-		-	3.230	2.192
Truck Transport Costs (N per ton)	-	-	-	0.442	0.804	1.482	-		-	1.353	1.916
Tractor Transport Costs (N per ton)	-	-	-	1.25	1.25	1.25	-		-	1.25	1.25
Road Improvement (N per ton)	-	-	-	0.129	0.129	0.129	-		-	0.129	0.129
Total Cost (N per ton)	13.932	17.708	9.234	9.661	7.431	6.001	-		-	5.962	5.487
Oil Extraction (tons/ton of ffb)	0.192	0.192	0.170	0.220	0.220	0.220	-		-	0.220	0.220
Value of Oil at Millgate [2/] (price N 195.0/ton)	37.440	37.440	33.150	42.900	42.900	42.900	-		-	42.900	42.900
Kernel Extraction (tons/ton of ffb)	0.045	0.045	0.045	0.049	0.049	0.050	-		-	0.050	0.050
Value of Kernels at Millgate [3/] (price N 86,5/ton)	3.893	3.893	3.893	4.239	4.239	4.325	-		-	4.325	4.325
Total Value per ton ffb (N)	41.333	41.333	37.043	47.139	47.139	47.225	-		-	47.225	47.225
Return per ton of ffb (N)	27.401	23.625	27.809	37.478	39.708	41.224	-		-	41.263	41.738

1/ This analysis is done in 1973 prices as compared with other analyses in this report, which reflect all end 1973/early 1974 prices.
2/ 1974 value of palm oil of N 219.3 (Supplement 12, table 12) changed in 1973 terms by using index 1974 = 100
1973 = 88.9.
3/ 1974 value of kernels of N 97.2 (Supplement 12, table 13) changed in 1973 terms by using index 1974 = 100
1973 = 88.9.

Supplement 5
Appendix 2
Table 1

NIGERIA

OIL PALM PROJECTS

Cost of transportation by Truck for a Single Central Mill of 40 tons/hr.

Collection Point	Tons ffb Year	Km to Mill	Tons km/Year	Costs/Year 2/
1	18,560	35	649,600	43,523
2	12,960	24	311,040	20,840
3	12,320	33	406,560	27,240
4	14,080	16	225,280	15,094
5	8,320	0 1/	0 1/	0 1/
6	13,120	16	209,920	14,065
7	13,120	14	183,680	12,307
12	8,640	30	259,200	17,366
13	9,280	30	278,400	18,653
14	9,600	50	480,000	32,160
11	12,640	63	796,320	53,353
8	11,840	38	449,920	30,145
9	6,400	28	179,200	12,006
10	9,120	16	145,920	9,777
	160,000		4,575,040	306,529

Average truck transport cost per ton ffb: ₦ 1.916

1/ Central mill located at collection point 5.

2/ Cost/ton km estimated at 6.7 kobo.

Supplement 5
Appendix 2
Table 2

NIGERIA

OIL PALM PROJECTS

Cost of Transporting Bunches by Truck for 2 Mills: 30 tons/hr and 10 tons/hr

Collection Point	Tons ffb/Year	Km to Mill	Tons Km/Year	Costs/Year 2/
1	18,560	35	649,600	43,523
8	11,840	38	449,920	30,145
2	12,960	24	311,040	20,840
10	9,120	16	145,920	9,777
9	6,400	28	179,200	12,006
5	8,320	0 1/	0 1/	0 1/
4	14,080	16	225,280	15,094
3	12,320	33	406,560	27,240
6	13,120	16	209,920	14,065
7	13,120	14	183,680	12,307
Subtotal 30 t/hr mill	119,840		2,761,120	184,997
12	8,640	13	112,320	7,525
13	9,280	15	139,200	9,326
14	9,600	3	28,800	1,930
11	12,640	15	189,600	12,703
Subtotal 10 t/hr mill	40,160		469,920	31,484
Total 2 Mills	160,000		3,231,040	216,481

Average truck transport cost per ton ffb: ₦ 1.353

1/ 30 t/hr mill located at collection point 5.
2/ Cost/ton km, estimated at 6.7 kobo.

NIGERIA

OIL PALM PROJECTS

Cost of Transporting Bunches by Truck for 2 Mills: each of 20 tons/hr

Collection Point	Tons ffb/Year	Km to Mill	Tons km/Year	Cost/Year 1/
1	18,560	12	241,280	16,166
8	11,840	13	153,920	10,313
2	12,960	15	194,400	13,025
10	9,120	13	118,560	7,944
9	6,400	25	160,000	10,720
4	14,080	25	352,000	23,584
3	12,320	27	332,640	22,287
Total Mill No. 1	85,280		1,552,800	104,039
5	8,320	45	374,400	25,085
6	13,120	56	734,720	49,226
7	13,120	31	406,720	27,250
12	8,640	13	112,320	7,525
13	9,280	15	139,200	9,326
14	9,600	3	28,800	1,930
11	12,640	15	189,600	12,703
Total Mill No. 2	74,720		1,985,760	133,045
Total 2 Mills	160,000		3,538,560	237,084

Average truck tranportation cost per ton of ffb: N 1.482

1/ Cost/Ton km estimated at 6.7 kobo.

Supplement 5
Appendix 2
Table 4

NIGERIA

OIL PALM PROJECTS

Cost of Transporting Bunches by Truck for 4 mills: each of 10 tons/hr

Collection Point	Tons ffb/Year	Km to Mill	Tons Km/Year	Cost/Year 2/
1	18,560	13	241,280	16,166
8	11,840	13	153,920	10,313
2	12,960	15	194,400	13,025
Total Mill No. 1	43,360		589,600	39,504
9	6,400	15	96,000	6,432
4	14,080	9	126,720	8,490
3	12,320	8	98,560	6,604
Total Mill No. 2	32,800		321,280	21,526
10	9,120	16	145,920	9,777
5	8,320	0 1/	0 1/	0
6	13,120	16	209,920	14,065
7	13,120	14	183,680	12,307
Total Mill No. 3	43,680		539,520	36,149
12	8,640	13	112,320	7,525
13	9,280	13	139,200	9,326
14	9,600	3	28,800	1,930
11	12,640	15	189,600	12,703
Total Mill No. 4	40,160		469,920	31,484
Total 4 Mills	160,000		1,920,320	128,663

Average truck transport cost per ton: N 0.804.

1/ One mill located at collection point 5.
2/ Cost/ton km estimated at 6.7 kobo.

Supplement 5
Appendix 2
Table 5

NIGERIA

OIL PALM PROJECTS

Cost of Transporting Bunches by Truck for 8 mills: each of 5/6 tons/hr

Collection Point	Tons ffb/Year	Km to Mill	Tons Km/Year	Cost/Year 3/
1	18,560	13	241,280	16,166
10 1/	4,560	13	59,280	3,972
Total Mill No. 1	23,120		300,560	20,138
8	11,840	9	106,560	7,140
2	12,960	0 2/	0	0
Total Mill No. 2	24,800		106,560	7,140
9	6,400	14	89,600	6,003
3	12,320	0 2/	0	0
Total Mill No. 3	18,720		89,600	6,003
4	14,080	0 2/	0	0
5 1/	4,160	16	66,560	4,460
10 1/	4,560	23	104,880	7,027
Total Mill No. 4	22,800		171,440	11,487
6	13,120	0 2/	0	0
5 1/	4,160	16	66,560	4,460
Total Mill No. 5	17,280		66,560	4,460
7	13,120	16	209,920	14,065
12	8,640	0 2/	0	0
Total Mill No. 6	21,760		209,920	14,065
13	9,280	12	111,360	7,461
14	9,600	0 2/	0	0
Total Mill No. 7	18,880		111,360	7,461
11	12,640	0 2/	0	0
Total Mill No. 8	12,640		0	0
Total 8 Mills	160,000		1,056,000	70,754

Average truck transport cost per ton: ₦ 0.442

1/ The production of the collection points 5 and 10 has been divided into two parts.
2/ Mills located at collection points 2, 3, 4, 6, 12, 14 and 11.
3/ Cost/ton km estimated at 6.7 kobo.

NIGERIA

OIL PALM PROJECTS

Basic Steam, Power and Water Requirements for Mills of Varying Sizes

1. Steam is required for sterilization, clarification and the dryers.

2. Power is required for driving the equipment.

3. Water is required for the boilers, clarification and the hydrocyclones or claybaths.

Steam Production

4. Approximately 500 kg of steam are required to process 1 ton of ffb.

5. For mills with a throughput of 10 tons of ffb/hr or more. Boilers would be of the water tube-type with forced draught. Their unit capacity would range from 6 to 11 tons of steam per hour at a pressure of 20-22 kg per cm^2 and the steam would be overheated to about 300°C. The water and fuel feed systems would be automatic and one fireman would be capable of operating one boiler.

6. For mills with a throughput between 3 and less than 10 tons of ffb/hr. Boilers would be of the locomotive type with natural draught. Their capacity per unit would be about 3 tons of steam per hour at 13 to 15 kg per cm^2. The water and fuel feed systems are usually automated and one fireman operates one boiler.

7. For mills with a throughput below 3 tons of ffb/hr. Boilers would be of the vertical "Field" type using natural draught. Their capacity per unit would range from 600 kg to 1200 kg of saturated steam per hour at a pressure of 8 to 12 kg per cm^2. These boilers are manually stocked by one or two firemen. The investment cost of the different types of boilers per ton of steam/hour and consequently, per ton of ffb processed is practically the same. However, the smaller boilers have a lower thermal efficiency and they produce steam at a lower pressure and temperature.

Power Production

8. Mills with a capacity of 10 tons of ffb/hr or more are normally equipped with water tube-type boilers providing overheated steam at 20 kg per cm^2. Part of the steam produced is used to drive turbo-alternators and the exhaust steam from these turbines is not lost but is used for processing. As a result of this steam recovery and the high efficiency of the boilers, no fuel problems arise and usually only part of the shells are required.

9. Mills with a throughput between 3 and 10 tons of ffb/hr. The steam generated by the locomotive boilers is saturated and at a pressure that is too low to drive turbines. The power is generated by steam engines driving medium speed alternators (500-750 rpm). Again the exhaust steam is recovered for use in processing but as the efficiency of the smaller boilers as well as the engines is lower than the efficiency of the equipment used in the larger mills, all the fibers and shells are required for fuel.

10. For mills with a throughput of less than 3 tons of ffb/hr. Due to the low efficiency of the Field type boilers and the low pressure of their steam, power cannot be generated by steam engines. This means that diesel engines have to be installed to drive the equipment.

Water Requirements

11. Mills require 1 ton of water per ton of ffb processed; half of it for the boilers and the balance for the hydrocyclones or claybaths. The water pumps are proportionately cheaper for the large mills but their more sophisticated boilers require expensive water treatment plants.

NIGERIA

OIL PALM PROJECTS

Rate of Return Calculation Using Large Scale Processing
(Naira '000)

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993/2004
COSTS																			
Smallholder field establishment	96.7	415.0	636.2	818.6	1,099.1	998.8	504.4	382.1	200.1	-	-	-	-	-	-	-	-	-	-
Labor	30.0	217.4	349.0	425.8	560.8	538.1	212.9	136.5	58.5	-	-	-	-	-	-	-	-	-	-
Local costs	38.2	103.1	135.8	171.6	216.2	152.4	66.5	55.1	31.3	-	-	-	-	-	-	-	-	-	-
Foreign Exchange Costs	28.5	94.5	151.4	221.2	322.1	308.3	225.0	190.5	110.3	-	-	-	-	-	-	-	-	-	-
Smallholder Field Maintenance	-	-	-	-	-	104.9	265.6	408.7	595.9	787.5	792.2	731.7	737.3	738.0	734.0	725.0	715.2	712.0	712.0
Labor	-	-	-	-	-	34.1	88.6	146.3	223.1	304.3	320.6	331.7	337.3	338.0	334.0	325.0	315.2	312.0	312.0
Local Costs	-	-	-	-	-	15.7	39.1	57.2	85.6	108.6	100.3	92.0	92.0	92.0	92.0	92.0	92.0	92.0	92.0
Foreign Exchange Costs	-	-	-	-	-	55.1	137.9	205.2	289.2	374.6	341.3	308.0	308.0	308.0	308.0	308.0	308.0	308.0	308.0
SMU - management and overhead costs																			
SMU Headquarters capital costs	59.1	45.4	-	11.1	9.4	-	8.1	6.4	-	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
SMU Headquarters personnel costs	132.6	185.3	136.2	136.2	107.5	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4
SMU Headquarters recurrent costs	9.2	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8
SMU Regional Units capital costs	140.4	137.9	29.6	12.3	55.8	24.0	12.3	-	-	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
SMU Regional Units personal costs	132.2	228.4	269.4	274.4	337.8	315.3	215.4	206.4	181.1	167.2	167.2	167.2	167.2	167.2	167.2	167.2	167.2	167.2	167.2
SMU Regional Units recurrent costs	14.1	26.2	31.0	31.0	37.4	37.4	21.4	21.4	21.4	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8
Road Improvement program	-	154.5	82.7	70.3	69.4	36.2	-	-	-	-	-	-	-	-	-	-	-	-	-
Training	53.6	58.2	24.4	16.0	39.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub total	541.2	800.7	588.1	566.1	671.6	536.1	380.4	357.4	325.7	323.6	323.6	323.6	323.6	323.6	323.6	323.6	323.6	323.6	323.6
Local costs	381.0	551.2	473.4	461.2	541.7	465.3	327.2	313.4	287.7	279.0	279.0	279.0	279.0	279.0	279.0	279.0	279.0	279.0	279.0
Foreign Exchange Costs	160.2	249.5	114.7	104.9	129.9	70.8	53.2	44.0	38.0	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6
Mill Investment	-	-	-	-	1,112.1	1,142.8	198.8	543.9	793.9	652.4	4.1	-	-	-	-	-	-	-	-
Fruit Collection Investment	-	-	-	-	-	108.8	65.8	143.1	66.1	156.6	82.4	167.6	83.4	223.7	139.7	139.7	139.7	139.7	139.7
Mill Recurrent 1/	-	-	-	-	-	-	96.5	130.7	151.1	158.2	186.0	181.4	189.3	191.2	191.2	191.2	191.2	191.2	191.2
Fruit Collection Recurrent	-	-	-	-	-	42.9	57.8	111.3	142.8	193.8	225.3	259.2	269.2	302.8	302.8	302.8	302.8	302.8	302.8
Sub total	-	-	-	-	1,112.1	1,294.5	418.9	929.0	1,153.9	1,161.0	497.8	604.2	541.9	717.7	633.7	633.7	633.7	633.7	633.7
Local costs	-	-	-	-	620.1	718.8	242.9	638.6	802.2	799.3	306.7	349.9	333.3	399.6	374.4	374.4	374.4	374.4	374.4
Foreign Exchange costs	-	-	-	-	492.0	575.7	176.0	290.4	351.7	361.7	191.1	254.3	208.6	318.1	259.3	259.3	259.3	259.3	259.3
Monitoring and Evaluation Division 2/	91.4	95.0	95.1	86.9	79.6	72.3	76.8	50.4	50.4	-	-	-	-	-	-	-	-	-	-
Total Costs 3/	765.8	1,376.2	1,385.4	1,565.2	3,110.5	3,156.9	1,728.4	2,233.9	2,442.3	2,272.1	1,583.6	1,659.5	1,602.8	1,779.3	1,691.3	1,682.3	1,672.5	1,669.3	1,669.3
of which - labor costs 3/	31.5	228.3	366.5	447.1	588.8	600.8	316.6	296.9	295.7	304.3	320.6	331.7	337.3	338.0	334.0	325.0	315.2	312.0	312.0
local costs 3/	504.4	753.9	706.5	725.6	1,502.9	1,470.6	769.5	1,153.0	1,300.5	1,186.9	686.0	720.9	704.5	770.6	745.4	745.4	745.4	745.4	745.4
foreign exchange costs 3/	229.9	394.0	312.4	372.5	1,018.8	1,085.5	642.3	784.0	846.1	780.9	577.0	606.9	561.2	670.7	611.9	611.9	611.9	611.9	611.9
labor costs 4/	20.5	148.4	238.2	290.6	382.7	390.5	205.8	193.0	192.2	197.8	208.4	215.6	219.2	219.7	217.1	211.3	204.9	202.8	202.8
local costs	504.4	753.9	706.5	725.6	1,502.9	1,470.6	769.5	1,153.0	1,300.5	1,186.9	686.0	720.9	704.5	770.6	745.4	745.4	745.4	745.4	745.4
foreign exchange costs 5/	275.9	472.8	374.7	447.0	1,222.6	1,302.6	770.0	940.8	1,015.3	937.1	692.4	728.3	673.4	804.8	734.3	734.3	734.3	734.3	734.3
Sub total	800.8	1,375.1	1,319.6	1,463.2	3,108.2	3,163.7	1,747.3	2,286.8	2,508.0	2,321.8	1,586.8	1,664.8	1,596.9	1,795.1	1,696.8	1,691.0	1,684.6	1,682.5	1,682.5
less taxes	(31.1)	(51.0)	(33.5)	(37.2)	(95.2)	(98.0)	(45.6)	(49.4)	(49.5)	(60.9)	(54.1)	(68.6)	(60.8)	(82.9)	(72.5)	(72.5)	(72.5)	(72.5)	(72.5)
Economic Costs	769.7	1,324.1	1,286.1	1,426.0	3,013.0	3,065.7	1,701.7	2,237.4	2,458.5	2,260.9	1,532.7	1,596.2	1,536.1	1,712.2	1,624.3	1,618.5	1,612.1	1,610.0	1,610.0
BENEFITS																			
Palm oil	-	-	-	-	-	44.7 7/	648.4	1,345.6	2,436.3	3,894.7	5,221.5	6,310.9	7,219.6	7,691.8	7,870.7	7,870.7	7,870.7	7,870.7	7,870.7
Kernels	-	-	-	-	-	6.0 7/	90.3	193.2	349.2	549.6	720.0	845.2	934.3	963.2	963.2	963.2	963.2	963.2	963.2
Residual value 6/	-	-	-	-	-	8.5	21.0	-	-	-	-	-	-	-	-	-	-	-	-
Total Benefits	-	-	-	-	-	59.2	759.7	1,538.8	2,785.5	4,444.3	5,941.5	7,156.1	8,153.9	8,655.0	8,833.9	8,833.9	8,833.9	8,833.9	8,833.9

1/ 130% of recurrent costs of mill in Owerri Nts to allow for recurrent costs due to the project investment of a 10 ton line of equipment in ADA's mill in the western part of the project area.

2/ 50% of costs of monitoring and evaluation division charged to oil palm projects, divided between states and smallholders and nucleus estate on per ha basis. 33% is foreign exchange, remainder local costs.

3/ Includes physical contingencies (5%) until 1983.

4/ Shadow priced at 65%.

5/ Shadow priced at $1 = N 1.27 as compared with $1 = N 1.52 which means a premium of 20%.

6/ Residual value of road equipment in 1980 (N 8,500) and of surplus SMU vehicles in 1981 (N 21,000).

7/ Oil Palm mill commissioned in 1981. Fruit processed before in ADA pioneer oil mills or sold in the local market. It is assumed that 25% of benefits will be realised under these circumstances.

Supplement 3
Appendix 3.4
Table 1

NIGERIA

OIL PALM PROJECTS

Economic Rate of Return Calculation, Using Small Scale Oil Processing Presses

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993/2004
COSTS																			
Smallholder Field Establishment	96.7	415.0	636.2	818.6	1,099.1	998.8	504.4	382.1	200.1										
Labor	30.0	217.4	349.0	425.8	560.	538.1	212.9	136.5	58.5										
Local Costs	38.2	103.1	135.8	171.6	216.2	152.4	66.5	55.1	31.3										
Foreign Exchange	28.5	94.5	151.4	221.2	322.1	308.3	225.0	190.5	110.3										
Smallholder Maintenance						104.9	265.6	408.7	595.9	787.5	762.2	731.7	737.3	738.0	734.0	725.0	715.2	712.0	712.0
Labor	-	-	-	-	-	34.1	88.6	146.3	223.1	304.3	320.6	331.7	337.3	338.0	334.0	325.0	315.2	312.0	312.0
Local Costs	-	-	-	-	-	15.1	39.1	57.2	83.6	108.6	100.3	92.0	92.0	92.0	92.0	92.0	92.0	92.0	92.0
Foreign Exchange	-	-	-	-	-	55.1	137.9	205.2	289.2	374.6	341.3	308.0	308.0	308.0	308.0	308.0	308.0	308.0	308.0
SMU Management and Overhead Costs																			
SMU headquarters capital costs	59.1	45.4	-	11.1	9.4	-	8.1	6.4	-	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
SMU headquarters personnel costs	132.6	135.3	136.2	136.2	107.5	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4
SMU headquarters recurrent costs	9.2	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8
SMU regional units capital costs	140.4	137.9	29.6	12.3	55.8	24.0	12.3	-	-	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
SMU regional units personnel costs	132.2	228.4	269.4	274.4	337.8	315.3	215.4	206.4	181.1	167.2	167.2	167.2	167.2	167.2	167.2	167.2	167.2	167.2	167.2
SMU regional units recurrent costs	14.1	26.2	31.0	31.0	37.4	37.4	21.4	21.4	21.4	19.8	19.8	19.8	19 8	19.8	19.8	19.8	19.8	19.8	19.8
Road improvement Program	-	154.4	82.7	70.3	69.4	36.2	-	-	-	-	-	-	-	-	-	-	-	-	-
Training	53.6	58.2	24.4	16.0	29.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-Total	541.2	800.7	588.1	566.1	671.6	536.1	380.4	357.4	325.7	323.6	323.6	323.6	323.6	323.6	323.6	323.6	323.6	323.6	323.6
Local Costs	381.0	551.2	473.4	461.2	541.7	465.3	327.2	313.4	287.7	279.0	279.0	279.0	279.0	279.0	279.0	279.0	279.0	279.0	279.0
Foreign Exchange Costs	160.2	249.5	114.7	104.9	129.9	70.8	53.2	44.0	38.0	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6
Investment in Small scale mills	-	-	-	-	-	200.0	350.0	550.0	850.0	1,050.0	800.0	600.0	450.0	100.0	-	-	-	-	-
Recurrent Expenditure small scale mills	-	-	-	-	-	72.9	255.2	453.5	896.8	1,389.7	1,773.3	2,048.0	2,263.3	2,333.3	2,333.3	2,333.3	2,333.3	2,333.3	2,333.3
Transportation 1/	-	-	-	-	-	37.9	30.9	63.6	52.2	87.6	76.9	105.7	88.1	131.6	110.6	110.6	110.6	110.6	110.6
Sub-Total	-	-	-	-	-	310.8	636.1	1,067.1	1,799.0	2,527.3	2,650.2	2,753.7	2,801.4	2,564.9	2,443.9	2,443.9	2,443.9	2,443.9	2,443.9
Local Costs	-	-	-	-	-	110.3	256.7	441.1	784.8	1,161.6	1,359.2	1,510.3	1,615.5	1,607.4	1,581.1	1,581.1	1,581.1	1,581.1	1,581.1
Foreign Exchange Costs	-	-	-	-	-	200.5	379.4	626.0	1,014.2	1,365.7	1,291.0	1,243.4	1,185.9	957.5	862.8	862.8	862.8	862.8	862.8
Monitoring and Evaluation Division 2/	91.4	95.0	95.1	86.9	79.6	72.3	76.8	50.4	50.4	-	-	-	-	-	-	-	-	-	-
TOTAL COSTS 3/	765.8	1,376.2	1,385.4	1,545.2	1,942.8	2,124.0	1,956.5	2,379.0	3,119.7	3,638.4	3,736.0	3,809.0	3,862.3	3,626.5	3,501.5	3,492.5	3,482.7	3,479.5	3,479.5
of which: Labor 3/	31.5	228.3	366.5	447.1	588.8	600.8	316.6	296.9	295.7	304.3	320.6	331.7	337.3	338.0	334.0	325.0	315.2	312.0	312.0
Local Costs 3/	504.5	753.8	706.5	725.6	851.8	831.7	778.0	945.7	1,282.2	1,549.2	1,378.5	1,881.3	1,986.5	1,978.3	1,952.1	1,952.1	1,952.1	1,952.1	1,952.1
Foreign Exchange Costs 3/	229.8	472.9	312.4	372.5	502.2	691.5	861.9	1,136.4	1,541.8	1,784.9	1,676.9	1,596.0	1,538.5	1,310.1	1,215.4	1,215.4	1,215.4	1,215.4	1,215.4
Labor Costs 4/	20.5	148.4	238.2	290.6	382.7	390.5	205.8	193.0	192.2	197.8	208.4	219.2	219.2	219.7	217.1	211.3	204.9	202.8	202.8
Local Costs	504.5	753.8	706.5	725.6	851.8	831.7	778.0	945.7	1,282.2	1,549.2	1,738.5	1,881.3	1,986.5	1,978.4	1,952.1	1,952.1	1,952.1	1,952.1	1,952.1
Foreign Exchange Costs 5/	275.8	567.5	374.9	447.0	602.6	829.8	1,034.3	1,363.7	1,850.2	2,141.9	2,012.3	1,915.2	1,846.2	1,572.1	1,458.5	1,458.5	1,458.5	1,458.5	1,458.5
Sub-Total	800.8	1,469.7	1,319.6	1,463.2	1,837.1	2,052.0	2,018.1	2,502.4	3,324.6	3,888.9	3,959.2	4,015.7	4,051.9	3,770.2	3,627.7	3,621.9	3,615.5	3,613.4	3,613.4
Less Taxes	(31.1)	(51.0)	(33.5)	(37.2)	(19.1)	(36.1)	(20.7)	(17.6)	(15.5)	(21.3)	(20.3)	(23.9)	(21.9)	(27.5)	(24.9)	(24.9)	(24.9)	(24.9)	(24.9)
Economic Costs	769.7	1,418.7	1,286.1	1,426.0	1,818.0	2,015.9	1,997.4	2,484.8	3,309.1	3,867.6	3,938.9	3,991.8	4,030.0	3,742.7	3,602.8	3,597.0	3,590.6	3,588.5	3,588.5
BENEFITS																			
Case A 6/																			
Palm Oil	-	-	-	-	-	178.9	648.4	1,345.6	2,436.3	3,849.9	5,020.3	5,908.4	6,591.7	6,797.4	6,797.4	6,797.4	6,797.4	6,797.4	6,797.4
Kernels	-	-	-	-	-	24.1	90.3	185.7	327.2	510.4	658.8	760.7	840.9	866.9	866.9	866.9	866.9	866.9	866.9
Remedial Value 7/	-	-	-	-	-	8.5	21.0	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL BENEFITS	-	-	-	-	-	211.5	759.7	1,531.3	2,763.5	4,360.3	5,679.1	6,669.1	7,432.6	7,664.3	7,664.3	7,664.3	7,664.3	7,664.3	7,664.3
Case B 6/																			
Palm Oil	-	-	-	-	-	178.9	626.1	1,255.7	2,200.2	3,409.5	4,350.4	5,023.0	5,552.4	5,724.2	5,724.2	5,724.2	5,724.2	5,724.2	5,724.2
Kernels	-	-	-	-	-	24.1	90.3	185.7	327.2	510.4	658.8	760.7	840.9	866.9	866.9	866.9	866.9	866.9	866.9
Residual Value 7/	-	-	-	-	-	8.5	21.0	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL BENEFITS	-	-	-	-	-	211.5	737.4	1,441.4	2,527.4	3,919.9	5,009.2	5,783.7	6,393.3	6,591.1	6,591.1	6,591.1	6,591.1	6,591.1	6,591.1

1/ Transportation for the assembly of oil is assumed to be 25% of fruit collection costs.

2/ 50% of costs of monitoring and evaluation unit charged to oil palm projects. Divided between states and smallholders and nucleus estates on ha basis. 33% is foreign exchange costs and the remainedar local costs.

3/ Includes physical contingencies (5%) until 1983.

4/ Shadow priced at 65%.

5/ Shadow priced at $1 = N 1.27 compared with $1 = N 1.52 which means a premium of 20%.

6/ Yield assumptions:

	Year 4	Year 5	Year 6	Year 7	Year 8 Onwards
Kernels (Case A and B)	4.0	4.5	4.5	4.5	4.5
Palm Oil (Case A)	16.0	17.0	18.0	19.0	19.0
Palm Oil (Case B)	16.0	16.0	16.0	16.0	16.0

7/ Residual value of road equipment in 1980 (N8,500) and of surplus SMU vehicles in 1981 (N21,000).

Supplement 5
Appendix 1
Table 2

Supplement 5
Appendix 4
Table 3

NIGERIA

OIL PALM PROJECTS

Sensitivity Analysis Rate of Returns for Small Scale and Large Scale Processing

			Small Scale Processing	
Costs	Benefits	Large Scale Processing	19% Extraction	16% Extraction
100	100	19.7	14.3	11.2
100	90	18.1	11.9	8.6
100	110	21.2	16.4	13.4
110	100	18.2	12.2	8.9
110	90	16.6	9.7	6.1
110	110	19.7	14.3	11.2
120	100	16.9	10.2	6.6
120	90	15.3	7.6	3.6
120	110	18.4	12.4	9.1

NIGERIA

OIL PALM PROJECTS

Field Studies of Small-Scale Processing Systems in Wild Palm Groves

1. The wild palm groves will continue to be a major source of Nigeria's palm oil for many years and there is a need to examine ways of improving the extraction of oil and kernels from this source.

2. NIFOR/UNDP have set up a program which includes -- "the development and building and testing of a complete range of small scale equipment." However, the program does not appear to include studying processing systems specifically adapted to meeting the needs of wild palm groves.

3. After discussions with the Director of NIFOR and the UNDP project manager, it was agreed that there is a need to establish field studies of processing systems geared to meeting the needs of the existing wild palm grove production.

4. These studies would be implemented by the NIFOR/UNDP program and would aim at:

(a) establishing simple but complete processing systems adapted to the production conditions of the wild palm groves;

(b) making comparisons between the dry and wet process of oil extraction by installing units such as the Vandekerckhove Rural Oil Palm Kit, the Wecker Hydraulic Press and the Hydraulic Hand Press; and

(c) evaluating such systems from the point of view of their technical, economic and socioeconomic suitability under actual field conditions.

5. The following are some broad guidelines to the type of research program that should be undertaken:

(a) The Wet Process, using the Vandekerckhove Rural Oil Palm Kit.

(i) making a comparison between sterilization in an autoclave under high pressure steam and sterilization under atmospheric pressure using locally made equipment:

(ii) determining the most effective digesting cycle in relation to the duration and quantity of water added;

(iii) separation of oil from the sludge. Assessing the value of a second boiling and settling tank. Timing the operations and making an assessment of the water requirements;

(iv) separation of the fiber from the nuts using a simple but efficient process that reduces handling - this could probably be done using a rotating screen or a blower; and

(v) establishing an efficient nut-cracking process; to include assessing the most effective autoclaving cycle and subsequently the speed at which the nut cracker should operate.

(b) The Dry Process

(i) examining the scope for operating the hydraulic hand press using a mechanically driven pump (to reduce the manual labor input) and comparing the results with those previously obtained at NIFOR; and

(ii) developing a simple digester for the preparation of the fruit in order to replace the heavy labor element involved in normal pounding.

6. If the dry processing gives good results with wild grove fruit, then it might be justifiable to carry out further studies using the Wecker hydraulic press. As in the wet process program, studies should be made to determine the most efficient way to sterilize the fruit; separate the fibre from nuts; and cracking the nuts.

7. All these technical studies should be made using Dura fruit from wild palm groves. It must be emphasized that the design of processing systems used in the wild grove areas should be simple and robust in order to keep the mechanical skill required for operation and maintenance to a comparatively unsophisticated level.

8. Prior to installing any type of processing system in the wild grove areas, the equipment would have to be tested at NIFOR to assess its suitability and determine the most appropriate methods to be used in the field.

9. Economic Research would comprise making cost/benefit analyses for the different processing systems, carrying out studies to determine the size and number of processing units required for any given area. Assessing farmer response to the introduction of these units and measuring their economic and social impact in the areas concerned.

10. Training. A program of practical training should be developed at NIFOR to enable the small processing units to be built and operated in the selected areas. When the units have been built, on the spot training should be given to local people so that eventually these systems can be taken over and run on communal/co-operative lines.

Estimated Costs of Program

11. The technical staff for these studies would be provided by the UNDP/NIFOR program and the estimates given below only relate to the purchase of equipment and running costs for 6-month operation. The estimates can only be considered as tentative in that precise details of the type of processing units to be finally established cannot be assessed at this juncture.

12. The cost of a Vanderkerckhove rural oil palm kit, installed in an existing building, such as an old abandoned pioneer mill, would be about ₦ 50,000. Two such sites were located by the appraisal mission:

- near Okwohia on the river Onuiyin north and west of Umuahia;
- near Ikeuebara on the river Mba north and east of Owerri.

The actual price of a Wecker hydraulic press is not known, but it would be higher than the rural oil palm kit and for estimation purposes is costed at ₦ 60,000. Details of the capital and recurrent expenditure for these field studies are given in Appendix 1 together with capital expenditure for equipment required for the NIFOR training center.

NIGERIA

OIL PALM PROJECTS

Field Studies of Small-Scale Processing in Wild Palm Groves

and Equipment needed at NIFOR Training Centre

(Naira '000)

		1975		1976		1977	Total	Foreign Exchange %	Foreign Exchange Amount
A Research Program									
Capital Expenditure									
Vanderkerkhove oil palm kit	(2)	100.0	(1)	50.0			150.0	80	120.0
Wecker hydraulic Press			(1)	60.0	(1)	60.0	120.0	80	96.0
Four-wheel drive	(1)	4.1					4.1	60	2.5
		104.1		110.0		60.0	274.1		
Recurrent Expenditure									
Unit operating costs /1	(2)	10.0	(2)	10.0	(1)	5.0	25.0		
Vehicle Operating costs	(1)	1.2	(1)	1.2	(1)	1.2	3.6		
		11.2		11.2		6.2	28.6	40	11.4
Total research program		115.3		121.2		66.2	302.7	76	229.9
Physical contingencies (5%)		5.8		6.1		3.3	15.2	76	11.6
Price contingencies /2		23.2		38.0		29.1	90.3	76	68.6
Total research program		144.3		165.3		98.6	408.2	76	310.1
B Equipment needed at NIFOR training centre									
Hostel water supply installation		20.0					20.0	80	16.0
Minibuses (3 @ N 7,000)		21.0					21.0	60	12.6
Teaching equipment /3		20.0					20.0	40	8.0
Beds for hostel (50 @ N 20)		1.0					1.0		
Chairs/desks/cupboards (50 @ N 40)		2.0					2.0		
Kitchen Equipment /4		7.0					7.0	80	5.6
		71.0					71.0	59	42.2
Physical contingency (5%)		3.6					3.6	59	2.1
Price contingency /5		14.9					14.9	59	8.8
Total NIFOR equipment		89.5					89.5	59	53.1
C Grand Total (without contingencies)		186.3		121.2		66.2	373.7	73	272.1
Physical contingencies		9.4		6.1		3.3	18.8	73	13.7
Price contingencies		38.1		38.0		29.1	105.2	73	77.4
Grand total		233.8		165.3		98.6	497.7	73	363.2

/1 N 5,000 per unit for first six months.
/2 14/11/7.5% compounded range for capital expenditure; 7% compounded for recurrent costs; price contingencies calculated from 1974 onwards over base costs and physical contingencies.
/3 Includes photographic material.
/4 Cookers and refrigerators.
/5 14/11/7.5% compounded range; price contingencies calculated from 1974 onwards over base costs and physical contingencies.

Supplement 1
Table 1

July 31, 1974

NIGERIA

OIL PALM PROJECTS

Road Improvement

Introduction

1. All three States (Western State, Mid-Western State, and East Central State) have well developed communication systems consisting of roads, navigable rivers, and railroads. Domestic air services are provided by Nigerian Airways. 1/

2. Federal "A" roads provide trunk links between the Federal and State capitals, other large towns, ports, and neighboring countries. They were built by the Federal Ministry of Works and Housing in Lagos, but are maintained by the State authorities acting as executing agents for the Federal Government. The 2-lane paved roads are generally in good condition.

3. The "B" roads (Western State 2,300 km, Mid-Western State 2,400 km, and East Central State 2,150 km) are State trunk roads, connecting the State capital with larger towns and divisional headquarters. They are constructed and maintained by the State Ministries of Works and Transport. Although the formation of the roads is built to a 2-lane standard, only one lane is paved, which creates maintenance problems at the shoulders caused by passing and overtaking vehicles. The roads are not well maintained and need urgent improvement. Most of the bridges in Mid-Western and East Central States are "temporary" Bailey-bridges, which were erected after the civil war and have not been replaced by permanent new bridges.

4. The States have extensive networks of earth roads (Western State 9,500 km, Mid-Western State 6,000 km, and East Central State 15,000 km) which connect the many villages with each other and with the trunk road network. The roads were built by the State Ministries of Works and Transport and handed over to the local authorities for maintenance. The roads were designed to a very low standard--in effect, narrow tracks that are barely passable for vehicles--and are today in poor condition.

5. The State Ministries of Works and Transport are in charge of "A", "B", and some of the earth roads. These ministries are understaffed, their organization is not efficient, and shortage of funds has resulted in poor road maintenance.

6. There is no formal machinery for coordination or consultation between the Federal and State Governments on matters concerning roads. The Federal Government has no direct control over the State's highway expenditures, not even over the funds provided for the maintenance of Federal roads by the State's Ministries of Works and Transport.

1/ More detailed descriptions are in the appraisal reports.

7. The Federal and the State authorities are both aware of the problem and in 1968 commissioned the Danish consulting firm KAMPSAX to undertake a study of the trunk road situation. KAMPSAX recommended that both "A" and "B" roads should be the responsibility of the Federal Government. It also recommended that administration should consist of an autonomous Federal highway administration with a highway department in each state responsible for the construction and maintenance of all trunk roads. The re-classification of the trunk "A" roads according to the "grid" proposed by KAMPSAX has been effected and interministerial discussions on the organization of highway authorities as a separate agency are now underway.

Paved Roads

8. The paved roads within the project areas are mostly class "B" roads, built to the standard of a 2-lane highway with a 24 ft wide carriageway and 8 ft shoulders. However, only one land (12 ft) of the carriageway has been paved, as a result of which vehicles must drive on the shoulders while meeting and overtaking other vehicles. The shoulders, which consist mostly of laterite, but also of earth taken directly from the roadside, have been compacted by the traffic only. Even at a moderate flow of traffic, the shoulders quickly subside and the edges of the pavement gradually break off until most of the pavement has vanished.

9. Moreover, the roads were built 12 to 15 years ago and due to lack of maintenance they are rapidly deteriorating. The reason for the poor condition of today's paved roads can be summarized as follows:

(a) the low standard to which the roads were originally designed and built;

(b) the increase in axle load during the lifetime of the road: today 8 tons for single axle and 12 tons for tandem;

(c) shortage of maintenance funds and equipment;

(d) organizational disruption following the creation of the 12 new states;

(e) administrative delays in providing maintenance funds; and

(f) poor management, low standards of workmanship and material control.

10. As a result, the paved roads are today characterized by potholes in the paved surface, deteriorated shoulders and shallow ditches. Water-logging during heavy rains leads to seepage into the pavement, which in time seriously weakens the base and results in the pavement breaking up. In some cases, the pavement has deteriorated completely, resulting in a very rough surface and, consequently, poor drainage.

11. For most of the paved roads within the project areas, immediate steps are needed to prevent further deterioration. Where the surface is still intact, the potholes should be cleaned and filled with good granular material, sealed with bituminous mix and compacted with a light roller or hand-controlled vibrator. The same procedure should be applied to the worn-out edges of the pavement. Where potholes are too numerous, it might be cheaper to re-seal the whole surface. The shoulders need to be reshaped with fresh material and compacted, the ditches must be cleaned and deepened in order to allow a quick runoff of the rainwater from the carriageway. The costs of these repairs would amount to about ₦ 1,200 to ₦ 1,800 per kilometer.

12. However, it should be emphasized that the above steps must be considered as a temporary remedial measure. The roads were originally built to a standard which does not lend itself to the actual increase in traffic that has occurred. Base failures will soon occur, resulting in undulation and finally breakup of the pavement. In the long run, it will be necessary to scarify the remaining pavement, provide a new base and repave the surface as a 2-lane paved carriageway. The cost of such a reconstruction would amount to ₦ 30,000 to 40,000 per kilometer.

13. An efficient trunk road network is essential to an effective oil palm fruit collection system. It would, therefore, be prudent to ensure that government estimates provide for the funds necessary for repairs and/or reconstruction on the lines indicated above.

Earth Roads

14. General. The existing earth roads have varying but generally insufficient jungle clearance and are, in effect, narrow tracks with no shoulders or ditches, and with rutted and rough surfaces. The alignment is usually good and can be retained, but the tracks will have to be reshaped into low-cost all-weather roads of proper design.

15. Design Standards. The design standards to which the new earth roads should be built are indicated in the chart attached to this Supplement where a cross section of the road is shown. The carriageway should be 3.60 m with shoulders of 1 m on each side. To enable the runoff of the rainwater from the carriageway to form a sheet of water of uniform depth, so as to keep the infiltration and the gullying to a minimum, the side slopes should be about 4 to 5%, giving the road a camber of 15 to 20 cm.

16. The ditches made by a bulldozer should be given a V-shape, with the bottom of the ditch at least 60 cm lower than the crown of the carriageway to prevent seepage into the formation. Natural outlets for the rainwater collected in the ditches are essential. Construction of culverts in proper locations will help solve the drainage problem.

17. In order to obtain a quick dry-out of the road surface after a rainstorm, trees and underbrushes on each side of the road should be cleared wide enough to leave the formation of the road properly exposed to air and

sunshine so that the evaporation of moisture from the road surface is accelerated. The road formation should also be outside the drip line of the trees.

18. Cost of Reconstruction. The upgrading of earth roads to the standards discussed above would be done by a construction team 1/ or contractors 2/ working under the supervision of a road engineer and his staff. Costs excluding supervision and depreciation, are estimated as follows:

(a) N 360/km for improving an existing earthroad to tractor/trailer standards.

(b) N 560/km for improving an existing earthroad to truck standard.

(c) N 430/km for constructing a new earthroad to tractor/trailer standards.

(d) N 610/km for constructing a new earthroad to truck standard.

If depreciation is included, the above costs are respectively N495, N 675, N545, and N 725.

19. The construction should be done as follows. After trees and underbrush have been cleared away, the road surface should be scarified, the top soil being removed by a bulldozer. The rotovator, pulled by a tractor, loosens the soil; then the bulldozer cuts the ditches and moves the earth towards the center of the road, gradually building up the formation. Additional material, if required, is hauled by two tippers. Each layer of the formation is compacted by a roller. A grader is then used to establish the final profile of the road.

20. Concrete pipes should be used for culverts. They must be placed on a sand-filled cushion, the trench filled with the excavated material and thoroughly compacted. Box culverts constructed of hardwood could also be used; if properly maintained, such culverts have the same lifetime as the road.

Road Maintenance

21. A properly maintained road reduces vehicle operating costs and permits higher speeds and hence better utilization of vehicle time. Good maintenance of the roads within the project area is essential for the economic operation of the fruit collection system.

22. The paved roads, once repaired or reconstructed, should be regularly inspected. Potholes should immediately be filled; shoulders kept level with the pavement; and roadside ditches cleaned at monthly intervals. The annual costs of maintaining a paved road would amount to about N 600/km.

1/ In case of the Mid-Western State and East Central State.
2/ In case of the Western State.

23. Earth roads are more sensitive to proper maintenance than paved roads. Surface undulation being the most common problem, even with light traffic. Therefore, after heavy rain, a grader should be used to smooth out undulations, fill the ruts and the potholes, and bring the displaced material back to the carriageway thus restoring the camber. The grader should at the same time reshape the shoulders and clean the ditches. The annual cost of maintaining an earthroad would amount to about ₦ 100/km.

Administration of the Construction Program 1/

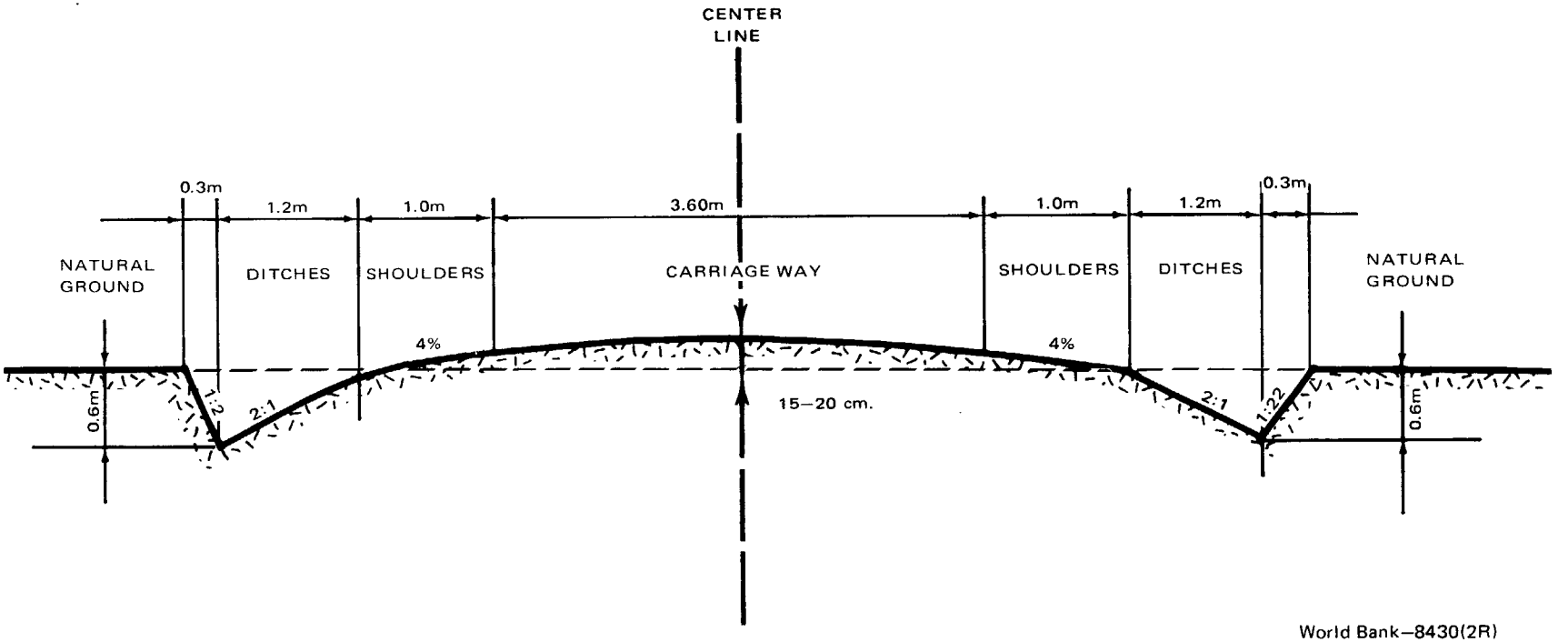
24. The earth roads program would require experience and skills which are in short supply in Nigeria. Neither the State Ministries of Works and Transport nor the consultants in the States (whether local or foreign) appear to have wide experience in building and maintaining all-weather earth roads. However, the timber companies, which construct such roads for extraction purposes, have personnel with adequate qualifications.

25. A road engineer should be engaged to organize and supervise the road construction program, assisted by two supervisors and two clerks. The road engineer should have wide experience in the construction of low-cost, all-weather earthroads and be recruited preferably from the timber exploiting companies.

26. The improvement of the earthroads could be executed by a construction team or contractor working under the supervision of the road engineer. In case of a construction team the equipment could, after completion of the work, be handed over to the PWD on the understanding that it would be used exclusively for the maintenance of the roads within the project area. The repair of the bridges would be undertaken by the local contractors.

1/ Cost calculations are in the appraisal reports.

NIGERIA
OIL PALM PROJECTS
CROSSECTION FOR IMPROVED AND NEW CONSTRUCTED EARTH ROADS



World Bank–8430(2R)

NIGERIA

OIL PALM PROJECTS

Fruit Collection

1. In planning a collection system for delivering the smallholder's fruit to the central mills, a combination of factors has to be considered. Firstly, the successful operation of a fully integrated central mill necessitates establishing a regular flow of fruit from the field to the mill reception center. To achieve this, all fruit collection and mill delivery systems should be controlled by the central mill. Secondly, the system has to cater for large numbers of relatively small production units that may be located at distance ranging up to 40 kilometers from the mill. Thirdly, oil palm fruit bunches are bulky and quite heavy (large bunches of Tenera material weighing up to 20 kilos each) which makes it both difficult and time consuming for producers to deliver fruit directly to the mill. This means that bunches have to be picked up either at the farm gate or at producer collecting points that are within reasonable head porterage distance. In the proposed projects the maximum distance that participating smallholders would have to carry fruit to a roadside pick-up point would be about 600 meters. Fourthly, in order to keep the build-up of free fatty acid to a minimum it is essential that fruit is transported to the mill rapidly and that handling procedures reduce fruit damage to a minimum. Finally, fruit handling systems must also provide quick, accurate and reliable means of loading and weighing individual producers' fruit bunches.

2. Choice with regard to the type of vehicles to be used for fruit collection, i.e., trucks, tractor/trailers or a combination of both, depends largely on the condition of the existing road network and the distances involved. Tractor/trailers can be operated effectively for relatively short hauls of 5-6 km on roads that are not suitable for all-weather use by 6-7 ton trucks. For distances ranging from 6 to 20 km trucks which are faster, but require better roads, are considered more suitable than tractor/trailers for direct fruit pick-up. Where a high proportion of road surfaces are paved, trucks would be more suitable than tractor/trailers for even longer hauls. However, in circumstances where the average haulage involves distances of around 30 km or more, a combination of tractor/trailers and trucks involving a two-stage system with central collection points is more economical.

3. Mechanized loading on to trucks or tractor/trailers would be done using rear mounted cranes fitted with built-in scales that would register the weight of individual smallholders' fruit at the pick-up point. The use of cranes and nets reduces loading time which in turn leads to better utilization of collection vehicles and eliminates individual handling of fruit

bunches thus reducing fruit damage and the build-up of free fatty acid. Estates in Malaysia that have used this system report a 57% reduction in fruit collection and transportation costs. Observations made during appraisal indicate that the average cost of fruit collection and transportation from smallholders in the Sapele area of Mid-Western State, using manual loading, amounted to over ₦ 1.00 per ton. Alternative estimates show that fruit collection and transportation costs can be reduced by about 25% when mechanized loading is used (see Appendix 1).

4. Harvested fruit bunches would be heaped in nets on the road side to await collection on a scheduled day. Nets would be delivered to the smallholders according to a predetermined timetable geared to the harvesting pattern of the areas involved. Smallholders would be notified well in advance of any changes in the collection schedule. The trucks would be accompanied by two special laborers. One of the laborers would stay on the truck, unhook the net from the crane, remove and stow away the emptied nets and stack the bunches. The other laborer would be responsible for attaching the filled nets to the crane. The driver, who would be in overall charge of the collection, would grade the fruit, operate the crane, record the weight and issue a receipt to the seller. The receipt would record the weight, grade and price to be paid.

5. Because palm fruit bunches tend to have a high volume/weight ratio, the trucks should have high-sided platforms in order to provide an effective carrying capacity of 7 tons of ffb. If loose fruits have to be loaded and weighed separately from fruit bunches, additional time would be required at each pickup. To avoid such unnecessary delays, it is recommended that collection nets have meshes that are not larger than 1 cm x 1 cm, thus enabling loose fruits and fruit bunches to be loaded and weighed simultaneously. The weighing scales should be robust, of simple construction, and easy to maintain to acceptable limits of accuracy in the field. As the smallholders are to be paid on the basis of the weight loaded at roadside pick-up points, it is important that they understand and have confidence in the whole procedure.

6. The estate fruit collection system would essentially be the same as that used for smallholders. Harvesting would be done by harvesting teams. Through the use of nets and cranes with built-in scales, the fruit bunches of individual harvesting teams would be weighed at the harvesting platforms.

7. Costs of smallholder and estate fruit collection following procedures outlined above are in the appraisal reports.

NIGERIA

OIL PALM PROJECTS

Comparison of Costs Between Manual and Mechanical Loading of FFB

(a) Malaysia (Estate Collection)

The labor and vehicles used for manual and mechanical loading are compared below; the data being based on a 1,000 ha estate of mature palms under Malaysian conditions.

	Tractors	Drivers	Attendants	Total Drivers and Attendants
Manual loading	6	6	12	18
Mechanical loading	3	4 /1	3	7
Savings	3	2	9	11

/1 The four drivers indicated are for three tractors and the motorcycle (used for net distribution) and figures given for vehicles and labor are for peak cropping periods.

With a manual loading system it took an average of two hours 20 minutes to load one 5/6-ton trailer. With mechanical loading it was possible to reduce the time taken to load the same trailer to an average of 28 minutes (i.e., five times as fast) and the cost of loading and transporting of fruit to the mill was reduced by 57%.

(b) Smallholder Fruit Collection (Cowan Estate)

The following table presents a comparison between fruit collection costs using mechanical loading and manual loading. The data for manual loading relate to the Ajagbodudu Estate's smallholder fruit collection system, while figures for mechanical loading are mission estimates for operation under identical road and collection situations.

	Personnel		Equipment			ffb	
	Drivers	Loaders	Maintenance	Depreciation	Total	Transported /1	Per Ton
	----------	----------	(Naira)	----------	----------	(metric ton)	
Manual	2.1 (1) /2	4.3 (3)	13.45	10.00	29.85	28	1.07
Mechanical /3	3.15 (1-1/2)	2.9 (2)	14.00 /4	13.44 /4	33.49	42	.80
(+) (-)	+1.05	-1.4	+.55	+3.44	+3.64		-.27

/1 Assumes than on a 10-hour working day, each truck using mechanical loading can make about 6 trips; with manual about 4 trips.

/2 Figures in parentheses indicate number of units.

/3 Assumes one Net Delivery Unit for two trucks.

/4 Including Net Delivery Unit.

NIGERIA

OIL PALM PROJECTS

Smallholder Operational Procedures

1. The project would aim at confining participation under the Grant/ Credit scheme to genuine operating farmers, with the minimum size qualifying for inclusion being 1 ha and the maximum confined to 10 ha. The minimum of 1 ha is considered to be the smallest area that it is administratively practical to accept under the project. The maximum of 10 ha of oil palm would provide employment for an extended farm family and allow it some time for the cultivation of food crops. Where land is owned communally, a maximum of 10 ha would be applied to each identifiable farm family unit within the community.

2. Notices calling for applications from smallholders and giving details of where forms can be obtained would be published through such media as local newspapers, radio and public administration offices, such as community centers. In order to facilitate the concentration of field staff, particularly in the year of planting when the heaviest intensity of farm visits is required, a zonal approach to development would be used. In any given year, applications for replanting/new planting would be restricted to specific zones within the project area. Allowance for any shortfall in applications from a given primary zone could be catered for by having an adjacent reserve zone from which applications could be requested but only be accepted in the event of there being a shortfall in the primary zone. To allow adequate time for applications to be filled and submitted by smallholders and appraised by SMU (TCU) technical staff, applications would be called for at the beginning of January of the year preceding planting and the closing date would be the end of March in the same year. Where applicable, the zones would be selected so as to coincide with the future location of the central fruit collection points. Agricultural Assistants (AA) will be the field staff in direct and continuous contact with the farmers and the aim should be to allocate these men to farms that are relatively close to one another, thereby reducing travelling time during farm visits and also facilitating the organization of demonstrations and group discussion activities. Field staff requirements have been derived using the following assumptions:

(a) one AA for every 80 ha in the year of planting - at an average size of 2 ha per smallholding, this would mean about 40 holdings per AA. At 4 farm visits per day for 5 days, the AA could visit each holding every 2 weeks;

(b) one AA for every 240 ha during the rest of the establishment period (3 years from planting). At 6 farm visits per day, the AA could visit each holding once every month;

(c) one AA for every 400 ha in maturity.

3. When an application has been approved under a given annual replanting/new planting program, the field operations pertaining to the first year of planting must be completed within the year to which the approval refers. At the end of each year, the approvals should be deemed to have lapsed in respect of the whole or part of any areas so approved, which have not been planted/replanted. The applicant would, however, be at liberty to submit a new application for any ensuing annual program for the specific area or zone in respect of such unplanted areas.

4. Grants/Credits would be made in respect of approved applications for replanting/new planting in accordance with any general or specific instructions which the SMU(TCU) may from time to time prescribe. Grant/Credit in cash or kind would only be made in respect of areas planted according to the standards specified by the SMU(TCU). In all instances payments in cash or kind would only be made subject to a field inspection report verifying that acceptable husbandry standards had been attained. Loan repayments would be deducted from the fresh fruit bunch sales proceeds according to the conditions specified in a loan agreement (see Supplement 10).

NIGERIA

OIL PALM PROJECTS

Grant/Credit Arrangements with Smallholders

1. Background. In the Oil Palm Rehabilitation Scheme introduced in the early 1960s and continued until the outbreak of civil war, smallholders received grants comprising (a) ₦ 100 per ha in cash towards the cost of land clearing and compensation for income lost, and (b) planting material and fertilizers valued at ₦ 10 per ha. The Mid-Western and East Central State propose continuing grants to smallholders for replanting/new planting including (a) planting material and fertilizers for crop establishment, and (b) ₦ 50 per ha in cash towards the cost of clearing and compensation for the loss of crop. (The South East State has introduced a similar rehabilitation scheme, but has increased the cash payment to ₦ 100 per ha.)

2. If Nigeria is to avoid becoming a major importer of palm oil, the old wild groves must be replanted with high yielding material. Past producer prices for palm oil have been substantially below world prices. The surpluses accruing to Marketing Boards have been largely used for development in other sectors; farmers have been unable to accumulate the savings they need to replant their farms. In addition, farmers suffer loss of income when old palms are removed, or other crops displaced, to allow new planting or replanting.

3. In previous rehabilitation programs, smallholders had been allowed to leave up to 20 palms standing until the new palms came into bearing. In the proposed projects, all old trees would be removed before planting to avoid the severe root competition and reduced light effect that results from leaving some of the old trees standing. In addition, because of the poor discipline maintained by smallholders with respect to encroachment into the root system areas of the young palms, the practice of intercropping during the first two years of planting is not recommended. The introduction of these strict technical standards would necessitate providing adequate compensation for loss of income through the cash element of the grant/credit package if the producers are to respond in the manner anticipated.

4. Establishment Costs. Estimated total costs of smallholder clearing, planting and establishment (at end 1973/beginning 1974 actual prices; and fertilizers and chemicals not at subsidized but at full cost) are as follows:

Year /1	- 1	0	1	2	3	Total
Labor						
Mandays	50	80	35	30	22.5	217.5
Cost	.....			₦ per ha	.....	
Cost (W, MW)	35.0	56.0	24.5	21.0	15.8	152.3
(EC)	32.5	52.0	22.8	19.5	14.6	141.4
Materials /2	-	98.8	20.3	26.0	35.4	180.6
Total (W, MW)	35.0	154.8	44.8	47.0	51.2	332.8
(EC)	32.5	150.8	43.1	45.5	50.0	321.9

/1 Year 0 is year of actual planting.
/2 **Not including cost of delivery from SMU (TCU) to smallholder but including hand tools** provided by smallholders themselves at an estimated cost of ₦ 10.

Grant/Credit Terms

5. Once accepted into the scheme, the farmer, provided he attained the husbandry standards required, would receive the inputs needed to establish and maintain his holding. The necessary means include both cash (for hiring additional labor) and materials, of which the latter account for about 55% of total establishment costs over Years - 1 to 3.

6. For reasons both of accounting simplicity and of presentation to the farmer, it is proposed to treat the provision of materials for planting as a straight grant by the SMU (TCU) and the cash assistance as a medium-term loan. Thus, of the total grant/credit 'package' offered by the project, almost two-thirds would be given as grant and the balance as loan; grant/credit would cover over 80% of estimated total establishment costs, the remainder (part of the labor required and hand tools) being provided by smallholders.

Schedule of Grant/Credit Disbribution in Field Establishment
(Value in Naira per hectare)

Year	0	1	2	3	Total
Grant:					
Cover crop seed	3.6				3.6
Palm seedlings	51.6				51.6
Wire netting	31.3				31.3
Fertilizers /1	7.4	15.3	21.0	30.4	74.1
Chemicals /1	2.5	2.5	2.5	2.5	10.0
Total	96.4	17.8	23.5	32.9	170.6
Credit:					
Cash	50.0	15.0	15.0	20.0	100.0
Total Grant/Credit:	146.4	32.8	38.5	52.9	270.6

/1 Fertilizers and chemicals fully costed, however subsidies are expected to be maintained at the rate of 50%.

7. The annual phasing of the cash assistance is intended both to reflect the labor required and to maintain an incentive to the smallholder during the years before his planting comes into bearing. Part of the high payment in Year 0 could in practice be used by him for 'retroactive financing' of labor hired for clearing, and ₦ 20 per ha would therefore be paid early in Year 0 at or just before the time of planting. In all instances the cash payments or supply of materials would be subject to a field inspection report verifying that acceptable husbandry standards had been attained.

8. The cash credit would be granted at a rate of interest of 9.5% for 13 years from planting, including a 7-year grace period during which interest would be capitalized. Indebtedness would thus reach ₦ 160 per ha by the end of the grace period. Equal annual installments over 6 years would then be ₦ 36.21 per ha; for simplicity, repayment would be by deductions (at a monthly rate equivalent to ₦ 3.00 per ha) from value of fruit bunch sales to the mill.

9. The rate of loan repayment proposed would allow a very satisfactory net return per ha to the grower on prices assumed. (See the appraisal reports for details.)

Short-Term Credit

10. Short-term credit would be made available for nonlabor maintenance inputs - particularly fertilizers - during the mature stage. Interest would be charged at 9.5% with repayment in twelve equal monthly installments commencing one month after disbursement.

11. The majority of smallholders involved in oil palm cultivation also grow food crops. The introduction of credit in the proposed project would establish an institutional framework for credit which could also be used to provide participating farmers with the credit needs of other enterprises such as food crops, using palm fruit sales as a collateral. Once smallholders have established their palms, SMU (TCU) would aim to hand over the provision of short-term credit for regular inputs to the cooperatives themselves as soon as practicable.

Arrangements for Grant/Credit Distribution

12. SMU (TCU) would be responsible for channelling materials and cash to the smallholders. To be eligible for project grant/credit assistance, smallholders would be required to be members of a registered Cooperative Society. 1/ SMU (TCU) staff would appraise the applicants for technical suitability and would assess their creditworthiness after consultation with the cooperative society concerned. Applications would be reviewed and approved by a Planting Authorization Committee (PAC) composed of the General Manager as chairman, the Controller of Field Operations, the Controller of Finance and a representative of the cooperative societies.

13. Successful applicants would sign a three-party loan agreement with their cooperative 1/ and with SMU (TCU), set out in accordance with Federal and State legal requirements and acceptable to the Bank. The Loan Agreement would stipulate the amount, terms, conditions and schedule of loan repayments and would include an undertaking by the smallholder to sell his fresh fruit bunches (ffb) to the central processing mill.

14. The grant/credit assistance would be limited to a minimum of 1 ha and a maximum of 10 ha per farm family. Credit payments would be made directly to smallholders at SMU (TCU) headquarters or regional unit offices. Delivery of grant-provided materials for planting would be made directly to smallholders by SMU (TCU) vehicles. The procedures involved in grant/credit distribution are summarized in Appendix 1.

15. Credit facilities would be provided through SMU (TCU) in conjunction with registered cooperatives since an institutional framework for agricultural credit is not yet sufficiently established in the project area. In addition, both the small scale of the credit operation relative to SMU (TCU) other costs

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1/ In the Western State the Western State Farmers Union (WSFU), if organized, funded and staffed in the forms acceptable to the Bank, would participate in the project as the cooperatives. The word cooperative therefore includes reference to WSFU for the Western State.

and its close relationship with SMU (TCU) technical supervision function make it desirable for credit disbursement, accounting and recovery to be handled within SMU (TCU). The smallholders loan accounts would be integrated with the accounts and statistical research maintained for the grant scheme and for the purpose of evaluating the progress of the project. Since the additional cost of maintaining the loan accounts would thus be relatively small, the cost of the staff and equipment required would be borne by SMU (TCU) (see Appendix 2).

Arrangements for Credit Collection

16. It is proposed to use registered Cooperative Societies as a medium for credit collection, and to restrict participation in the smallholder scheme to their members, for the following reasons:

(a) they offer the best assurance of individual credit worthiness;

(b) they will provide a mutual guarantee of loan repayment, since it is not feasible to rely on distraint of land or property for loan recovery;

(c) by involvement in the project, the cooperatives would be given a direct interest in representing smallholders' interests on the SMU (TCU) Steering Committee, on the Planting Authorization Committee (PAC), and on the Price Formulation Committee, all of which would include a representative of the State cooperative movement;

(d) involvement in the project would act as an important stimulus to the further development of community/ cooperative group activities in smallholder agriculture, which are already playing an active role; and

(e) payment to the societies of a margin in recognition of their loan repayment guarantees should benefit them financially (provided their members maintain a satisfactory rate of repayment) (see Appendix 3).

17. The processing mills, which are to be operated by separate commercial entities, would provide the SMU (TCU) with a bi-weekly summary of bunch purchases and a check for the full value thereof. The SMU (TCU) Accounting Unit would check this against its own copies of bunch purchase slip (bps) and, when verified, would analyze by cooperative society and individual smallholder, to determine the amount of loan repayments due. SMU (TCU) would then credit each Society's account with the value of its members' bunch sales during the previous month, less credit repayments due calculated on the basis of an interest rate of 7.5% (₦ 2.50 per ha planted per month over Years 7 to 12).

18. On receipt of funds to its account, each Society would then pay the net amounts owing to its members after deduction of credit repayments on the basis of the full interest rate proposed for the smallholder loans of 9.5% (₦ 3.00 per ha planted per month over Years 7-12).

19. The cooperative societies would also be the channel through which smallholders would receive any bonus paid by the central mills for fruit bunch purchases.

20. The procedures involved in credit repayment are summarized in Appendix 4.

NIGERIA

OIL PALM PROJECTS

Smallholder Grant/Credit - Distribution (Years-1 to 3)

1. Smallholder applies to join scheme.

2. SMU (TCU) inspects holding, consults with cooperative society on credit rating.

3. A. If Eupatorium infestation was under 30%, PAC reviews application, considering report on 2.

   B. If Eupatorium infestation was over 30%, PAC would not review application. Smallholder would be advised to clear his holding and would be instructed that the best way to do this would be to clear by taking a crop on this land. However, the smallholder could request a second inspection in December/January and if his holding is completely cleared, PAC would review his application.

4. If accepted, the smallholder, cooperative and SMU (TCU) sign three-party Loan Agreement (including Promissory Note).

5. PAC authorizes planting (1 - 10 ha per family).

6. SMU (TCU) issues first cash payment (N 20 per ha) after clearing and delivers first materials for planting.

7. SMU (TCU) continues to supply materials as appropriate, subject to acceptable progress reports and regular inspection from field assistants.

8. Each smallholder's participation in scheme reviewed annually by PAC (based on inspection reports by field assistants) and terminated if necessary, after adequate warnings given.

9. On satisfactory annual review by PAC, SMU (TCU) issues annual cash payments in arrear.

10. After the establishment period, when plantings start producing at least 2 tons/ha in Year 4, SMU (TCU) makes available seasonal inputs (viz. fertilizer) on short-term credit to smallholder, if required. Loan Agreement endorsed by smallholder, cooperative and SMU (TCU). Short-term credit probably not required after Year 8, when full yield attained.

NIGERIA

OIL PALM PROJECTS

Grant/Credit Accounting Control for Smallholders

1. SMU (TCU) would have to maintain separate accounts for individual smallholders (analyzed by cooperative society) to record the following basic information:

(a) disbursement of grant components in kind during the establishment period;

(b) disbursement of medium-term credit in cash during the establishment period;

(c) disbursement of seasonal credit in maturity (Year 4 from planting);

(d) weight, grade and value of fresh fruit bunches sold to the mill by dates;

(e) deductions made for the repayment of medium-term and seasonal credit;

(f) block payments to cooperatives.

2. SMU (TCU) would have to maintain smallholder accounts, each requiring 4 - 5 entries per year during the development period and 25 per year when harvesting commences. Since the recording requirements would be too numerous to be done manually, provision would be made for mechanical recording on individual cards using simple accounting machines each capable of registering about 10,000 entries per month. These machines can be operated by a specially trained typist. Number of smallholder accounts and machines needed are given below.

State	Smallholder /1 Accounts	Accounting Machines
Western State	2,000	1
Mid-Western State	4,000	2
East Central State	8,000	4

/1 based on an average farm size of 2 ha.

3. Project costs include provision for hiring consultants to establish a mechanized accounting system for SMU (TCU). This study would be carried out under the supervision of the Tree Crop Section of MEU to ensure the use of a standardized accounting system in all oil palm projects.

NIGERIA

OIL PALM PROJECTS

Financial Effect on Cooperatives

1. On the proposed phasing of distribution and repayment of the smallholder loans of ₦ 100 per hectare, repayments due from the smallholder to his cooperative are at ₦ 3.00 per hectare per month over 72 months, based on an interest rate of 9.5%. If the cooperatives are charged interest at a rate of only 7.5%, in recognition of their guarantee of loan repayments by their members, then their monthly obligation to SMU (TCU) in respect of members' planted area under the scheme amounts to only ₦ 2.50 per hectare per month. Thus with no default on members' repayments to the cooperatives, the Societies would gain a margin of ₦ 0.50 per month or ₦ 6.00 per year over the 6-year repayment period.

2. This margin is, in fact, sufficient to cover current repayment obligations to SMU (TCU) with a rate of default or arrears of up to 16.6% of members' own repayments. Net margin (loss) per hectare to cooperatives at different rates of default/arrears are shown below.

Percent default/arrears on smallholder repayments to Cooperatives	Net Margin (Loss) to Cooperative (Naira per hectare per year) /1
0	6.00
5	4.20
10	2.40
15	0.60
16.67	0.00
20	(1.20)
25	(3.00)

/1 The net margin for any intervening or higher rate of default can be calculated as follows $y = 6.0 - 36.x$;

y = net margin (loss)
6.0 = annual margin to cooperatives at no default (₦ 36.00-₦30.00 = ₦ 6.00)
36 = annual repayments by smallholder to cooperative (₦ 36.00)
x = percentage default.

Thus, provided that members' early repayments performance was reasonably satisfactory (default of not more than say 5%) the cooperatives would fairly soon accumulate surpluses to their account sufficient to tide them over any temporary decline in members' bunch sales to the mill, due for instance to seasonal low yields, and allow them to maintain full payment of their obligations both to SMU (TCU) and to growers. The importance of regular and prompt

cash payments to the smallholders is one of the main reasons for maintaining a 2% interest-spread in favor of the cooperatives.

3. Based on the smallholder planting programs proposed for the three projects, Table 1 summarizes the annual and cumulative effect of the credit arrangements on the cooperative movement finances in the three States, on assumed default rates of 0, 5, 10 and 15% (16.6% default marks break-even point for cooperatives).

4. Table 1 shows that even with default on smallholder repayments of 5%, the cooperatives in all three States should accumulate sizable cash surpluses as a consequence of the margin allowed to them on credit repayments to SMU (TCU). By the time, annual repayments reached their peak (project year 11), they would be in a position to have accumulated a cash reserve approximately equal to three months' repayments due to SMU (TCU). With satisfactory repayment performance by smallholders, surpluses over and above a prudent level of reserves would be available for financing of seasonal credit requirements or distribution to members whose accounts were in good standing. Distribution of mill bonuses through the cooperatives would also assist in maintaining a high rate of repayments to the cooperative and thus sustain their cash-flow position.

NIGERIA

OIL PALM PROJECTS

Credit Margin to Cooperative Societies
('000 Naira)

Project Year: / Year:	7 1983	8 1984	9 1985	10 1986	11 1987	12 1988	13 1989	14 1990	15 1991	16 1992	Cumulative Total
At 0% default (N 6.00/ha)											
Western State	2.4	6.0	10.8	20.4	24.0	24.0	21.6	10.0	13.2	3.6	144.0
Mid-Western State	4.0	12.0	21.6	33.6	48.0	48.0	43.2	36.0	26.4	14.4	288.0
East Central State	12.0	30.0	48.0	72.0	96.0	96.0	84.0	66.0	48.0	24.0	576.0
At 5% default (N 4.20/ha)											
Western State	1.7	4.2	7.6	14.3	16.8	16.8	15.1	12.6	9.2	2.5	100.8
Mid-Western State	3.4	8.4	15.1	23.5	33.6	33.6	30.2	25.2	18.5	10.1	201.6
East Central State	8.4	21.0	33.6	50.4	67.2	67.2	58.8	46.2	33.6	16.8	403.2
At 10% default (N 2.40/ha)											
Western State	1.0	2.4	4.3	8.1	9.6	9.6	8.6	7.2	5.3	1.5	57.6
Mid-Western State	1.9	4.8	8.6	13.4	19.2	19.2	17.3	14.4	10.6	5.8	115.2
East Central State	4.8	12.0	19.2	28.8	38.4	38.4	33.6	26.4	19.2	9.6	230.4
At 15% default (N 0.60/ha)											
Western State	0.2	0.6	1.1	2.1	2.4	2.4	2.2	1.8	1.3	0.3	14.4
Mid-Western State	0.5	1.2	2.2	3.4	4.8	4.8	4.3	3.6	2.6	1.4	28.8
East Central State	1.2	3.0	4.8	7.2	9.6	9.6	8.4	6.6	4.8	2.4	57.6

	Total Smallholder Area Planted (ha)	Peak Annual Repayments to SMU/TCU at 7.5% (N 30/ha)
Western State	4,000	120,000
Mid-Western State	8,000	240,000
East Central State	16,000	480,000

NIGERIA

OIL PALM PROJECTS

Smallholder Grant/Credit - Repayment

(Medium-term: Years 7 to 12; short-term Years 4 et seq.)

1. Collection system (mill) buys ffb from smallholder.

   Copies of bunch purchase slip (bps) to:

   (1) smallholder

   (2) SMU (TCU)

   (3) mill

2. Mill sends SMU (TCU) two weekly tabulation of bps and check for full amount without deductions.

3. SMU (TCU) (Accounts Unit) checks total against own copies of individual bps and analyses by cooperative coding.

4. SMU (TCU) posts credits to respective Cooperative accounts with SMU (TCU).

5. From individual smallholder cards, SMU (TCU) knows monthly repayment due from members of each cooperative; debits this amount - based on ₦ 2.50 per hectare (interest charged at 7.5%) - against each cooperative account.

6. Check for net amount issued direct to cooperatives bank account; Cooperative supplied with schedule of individual member's gross sales ffb (tons and value), individual member's repayments due - based on ₦ 3.00 per hectare (interest charged at 9.5%) - and net amount due to member.

7. Schedule is balanced with check payment from SMU (TCU) by credit entry for interest - spread on repayments due.

8. Cooperative pays out its members in cash, net of repayments at 10% (₦ 3.00 per ha); members can check own bps against cooperative's schedule.

9. Any member failing to send sufficient ffb to mill to cover monthly repayment would owe his cooperative; this debt would be shown on his individual card at SMU (TCU) and as a debtor's item in his cooperative account at SMU (TCU), and carried forward to the next month.

10. Short-term credit would need to be accounted separately from the medium-term loans but handled in the same way, on a flat rate monthly deduction from fruit sales with a margin to cooperatives in respect of repayment guarantees.

11. With interest-spread on credit of 7.5-9.5%, the margin to cooperative is sufficient to cover non-repayment/arrears equal to over 16% of monthly debt to SMU (TCU). 1/

12. Even if arrears temporarily exceed 16%, 2/ cooperative can still pay out its members in good standing in full by meeting the difference out of accumulated reserves, provided that initial repayments record is satisfactory (allowing cooperative margin to accumulate).

13. Cooperative members would only receive their share of biannual mill bonuses if all ther repayments were up to date; this would encourage early settlement of any arrears.

1/ In fact 16.67%.

2/ e.g. as a result of seasonally low bunch yields.

NIGERIA

OIL PALM PROJECTS

Training

1. Technical training at all levels will comprise a very important sector of project activity. To ensure an effective start-up in 1975, intensive training in selected spheres such as nursery and field planting techniques will need to be started as soon as possible. The type of training involved can be divided into four basic categories: Senior Officers, Nursery Staff, Field Staff, and Farmer Training. A schedule and estimate of the cost of training are given in the appraisal reports.

2. Senior Staff. Senior officers (Agricultural Officer or above) would be given 6 months refresher training in field planting techniques and management methods. These officers would be attached to large scale oil palm development schemes or commercial estates where appropriate husbandry standards were practiced. The scope for meeting these training requirements is somewhat limited in Nigeria and staff will probably have to be sent to neighboring countries such as the Cameroon and the Ivory Coast; in the case of the latter, the language problem may be a constraint. In certain cases officers might be sent to organizations such as the Federal Land Development Authority in Malaysia where they would get an opportunity to study modern planting techniques as well as management systems geared to small farmer operations. The establishments to which these officers are sent should be provided with quite detailed outlines of the spheres of field and management practice that require emphasis. On return these men would be expected to submit a full report on their work, giving details of the techniques and management systems studied.

3. Nursery Staff. For each Regional Unit, 2 Agricultural Assistants will need to receive special training in nursery techniques. In order to cover a complete schedule of nursery operations from the germinated seed stage to field planting, it will be necessary to allow a full twelve-month period for nursery training. If commercial estates with sufficiently extensive planting programs to justify large irrigated central nurseries (8 to 10 ha of main nursery) can be found in Nigeria, the nursery staff will be trained in Nigeria. In addition to training Agricultural Assistants, at least one Agricultural Officer should also be trained so as to assume overall responsibility for the nurseries. It is proposed for the Western and Mid-Western States that the estate nurseries would produce the planting material required for both the estates and smallholders 1976 planting program. SMU/FCU's nursery staff would be trained at these nurseries in 1975 and would establish central nurseries in the Regional areas in 1976 to meet the needs of the smallholders 1977 planting program. In East Central State in order to meet the needs of the 1976 planting program nurseries will have to be established in early 1975 and unless experienced staff are available training would have to commence in 1974.

4. Field Staff. Training would comprise a 3-month intensive course in modern planting techniques followed by 2-3 months practical training in the supervision of field operations on a large commercial estate. While the course would include the basic techniques of nursery cultivation, the emphasis would be on the methods and control of planting in the field and of post-planting operations. The intensive course of lectures and demonstrations would be given at NIFOR and an outline of a syllabus is shown in Appendix 1. The course would include visits to nearby estates (e.g., Ajagbodudu and Aden River) to demonstrate the employment of labor in the various operations. All field staff would also be trained in appraisal and grant/credit supervision procedures.

5. Refresher Courses. Short refresher courses should be arranged at NIFOR from time to time to ensure that all practices being used are up-to-date. In particular, it will be desirable for Agricultural Assistants to return for short courses in harvesting practice before their areas come into bearing. In the smallholders' areas harvesting discipline is going to be a critical factor in the early years and the importance of providing special training at the right time for both field staff and farmers cannot be overemphasized.

6. Farmer Training - would be developed on a group activity basis and would include:

i) simple outlining of application procedures and conditions of the loan agreement;

ii) demonstrations of specific planting practices at selected smallholdings;

iii) group discussions supported with visual aid material prior to, and in the course of, the agricultural planting program; and

iv) short courses of 1 to 2 days at the Regional Units or Headquarters.

7. Estates. Training would also be important on the estates, and the companies would be responsible for adequate training of all staff levels. However, the Estate managers and oil mill engineers would be recruited internationally if necessary. The estate managers would be responsible for the establishment of the estates and they would in the meantime train their successor, who would take over immediately after the last planting year (i.e., after five years). The oil mill engineers would be responsible for operating the mills until they reached full capacity. They would train their successors, who however would also be trained by the suppliers. This would be embodied in the suppliers' contract.

NIGERIA

OIL PALM PROJECTS

Outline of a course in oil palm planting techniques

Objectives - A course to be conducted at NIFOR for Agricultural Assistants aimed at providing them with a sound working knowledge of the basic practices involved in establishing and maintaining oil palm plantings.

Method - the approach used being essentially

(a) a lecture on a selected subject/practice followed by

(b) a field demonstration and/or observation followed by

(c) a discussion period

NIFOR advisory sheets and other papers to be issued at the lectures. For specific practices such as land clearing, lining and holing, cover crop establishment, planting, weeding, fertilizer application and harvesting, trainees would spend time in the field carrying out the various tasks involved so as to be in a position to demonstrate the practices to smallholders.

Duration - about three months divided into two periods to coincide with the main seasons for (a) land preparation and (b) planting.

A. Outline of Lectures

1. Timing of operations

Importance of timing under climatic conditions of Nigeria. Germination, pre-nursery, nursery, field planting sequence.

2. Seed collection and germination

(a) Planting material - the main types and their characteristics

(b) Controlled Pollination

(c) Seed collection and preparation

(d) Germination

(e) Packing and dispatch

3. Pre-nursery and Main Nursery

Pre-Nursery

(a) Preparation of the pre-nursery beds

(b) Examination of germinated seed on arrival

(c) Planting germinated seed in small polybags

(d) Maintenance in the pre-nursery

(e) Spraying against Anthracnose

(f) Roguing

Main Nursery

(a) Lining and soil preparation

(b) Bag-filling and placing

(c) Transplanting from the pre-nursery

(d) Blast, its incidence and control

(e) Maintenance - including operation of irrigation system, weeding, fertilizer application

(f) Spraying against Anthracnose and Cercospora

(g) Roguing

4. Land Preparation

(a) Timing of operations

(b) Underbrushing and felling

(c) Cutting up and beating down

(d) Burning and the protection of previously planted areas

(e) Lining

(f) Clearing of timber from planting points

5. Establishment and Maintenance of Cover Crop

(a) Preparation for sowing covers

(b) Seed treatment

(c) Sowing covers

(d) Maintenance of covers

6. Field Planting

(a) Timing of planting

(b) Planting density

(c) Age of transplants

(d) Method of planting

7. Upkeep of palms in the field

(a) Maintenance of circles, avenues and paths

(b) Manuring - diagnosis of nutrient requirements
- fertilizer trials, soil analysis, visual assessment of deficiencies
- foliar analysis
- application of fertilizers

(c) Pest and Disease Control
- recognition and control of the main pests and diseases encountered in the field
- control of Cercospora in the field

(d) Castration

(e) Pruning

8. Harvesting and Fruit Collection

(a) Objectives and organization of harvesting rounds

(b) Techniques of harvesting

(c) Fruit collection systems being used in project areas

B. Outline of Demonstrations

1. Seed Collection and Germination

(a) Planting material

Visit progeny trials to examine layout of trials, etc.

Shown methods of yield recording

Visit bunch and fruit analysis laboratory

Demonstration of controlled pollination in the field (to include pollen collection and drying techniques)

(b) Seed collection and preparation

Harvesting of labelled bunches

Depulping of fruits, seed treatment and preparation for the germinator

(c) Germination by dry heat treatment method

Visit germinator for demonstration of soaking, drying, dry-heat treatment, resoaking and retaining correct moisture content.

Examples of various stages of seed germination

Seed sorting and packing for dispatch

2. Pre-nursery and nursery techniques

(a) Preparation of pre-nursery site

(b) Planting in the pre-nursery

Condition of germinated seeds on arrival at the pre-nursery.

Detection of Brown Germ

Planting methods for germinated seed into small polybags

(c) Maintenance in the pre-nursery

Watering to run-off

Manuring. Preparation of ammonium phosphate and sulphate of ammonium solutions. Post-application watering. Demonstration of fertilizer scorch.

Spraying against Anthracnose

(d) Recognition and thinning out runts in pre-nursery, using slides and/or material to demonstrate seedlings displaying various undesirable characteristics

3. Main nursery (polybag nursery techniques)

(a) Planting in the main nursery

Examples of pre-nursery material at transplanting (4/5 leaf) stage

Demonstration and practice of bag-filling and transplanting

- initial soil filling
- removal of pre-nursery polybag
- placement in large polybag showing seedling collar 1/2 inch below rim of large polybag
- consolidation of soil around seedling root system
- spacing of polybags in the main nursery

(b) Maintenance

Preparation of fertilizer mixture

Fertilizer application - placed in a broad band and lightly scratched into soil surface

Weeding

(c) Pests, diseases and disorders

Routine inspection for snails, crickets, grasshoppers, caterpillars, and beetles

Diseases -- Early spraying against Anthracnose

-- Routine spraying against Cercospora

-- Control of Blast Disease. Importance of dry season irrigation

Detection of nutrient deficiency symptoms. Slide of symptoms.

(d) Recognition and thinning out of runts in the main nursery

Demonstration material consisting of slides, photographs and specimens showing habit and leaf abnormalities. Field trip to experimental areas where runts have been planted out.

4. Field Planting

(a) Time-of-transplanting demonstrations to be visited

(b) Methods of Eupatorium eradication before planting: digging, Triozone spraying

(c) Method of planting

Techniques of lining and holing
Planting young palms from polybags

(d) Cover crops

Seed mixtures, seed preparation methods

Demonstration of rates and method of sowing.

5. Upkeep of palms in the field

(a) Weeding

Field excursion to demonstrate (i) size of weeding circles for palms of varying ages (ii) slashing rounds: height and frequency

Patrolling for Eupatorium control

(b) Manuring

Field visits to show the layout and organization of a fertilizer trial

Study of fertilizers and field visits to demonstrate the visual effects of N, K, Mg and B deficiencies

(c) Pests, Diseases and Disorders

Field Pests -- shown a collection of main field pests

Diseases: Spraying against Cercospora in the field

Pruning of Cercospora-infected plants

Demonstration of characteristics of the diseases of young and adult palms by visits to areas where they exist: Basal Decay, Vascular wilt, Ganoderma Trunk Rot, Spear-Rot-Little-Leaf, Dry Basal Rot

(d) Castration

Field demonstration using chisel.

6. Harvesting

Recognition of bunch ripeness - field visit

Techniques of bunch cutting - chisel and knife

7. Yield in Oil Palm

Dissection of palm crown to show flowering processes

Examination of fruit composition of different fruit forms

Visits to a modern mill

C. Discussion Periods

Each main lecture and demonstration session should be followed by discussion periods.

NIGERIA

OIL PALM PROJECTS

Markets and Prices

A. World Supply and Demand Outlook for Palm Oil

1. The world supply of palm oil increased very rapidly in recent years following a long period of slow growth. From 1950-52 to 1967-69 world production rose at an annual average rate of 1.2% while from 1967-69 to 1971 the annual growth rate averaged more than 12%. World exports of palm oil, which practically stagnated throughout the 1950s and early 1960s, began to increase at a 15% average annual rate after 1967-69. By 1972 the share of palm oil in exports of all fats and oils had nearly reached the level at which it stood in the early 1950s.

2. World production of palm oil is expected to increase rapidly as new plantings of high-yielding varieties reach maturity. Oil palm projects financed by the Bank Group will contribute between 15 and 16% to the total increase in production during the decade from 1970 to 1980. Although the share of the output consumed domestically in producing countries will decline, total consumption of palm oil is expected to grow more rapidly in the 1970s than in the 1960s.

3. The demand for palm oil is largely influenced by the demand for all oils and fats and for vegetable oils as a group. Total estimated consumption of fats and oils expanded steadily at a trend rate of 2.9% from 1960 to 1970, but both the geographic and the product composition of demand changed during this period. While consumption in developed and developing countries rose at a trend rate of 3.2% the trend rate of growth reached only 1.8% in centrally planned economies. Developed countries which represent the main export market for fats and oils produced in developing countries, accounted for one-half of the total world consumption in 1970. Demand for palm oil rose most rapidly in Oceania, Japan and South Africa combined (7.0% per annum), followed by Western Europe (3.0% per annum) and the United States and Canada (2.6% per annum). Among the developing regions, Latin America recorded the greatest trend rate of growth in consumption (4.3%) followed by Africa and Asia.

4. The past decade saw a significant change in the pattern of consumption of fats and oils -- away from animal fats and oils towards vegetable oils. Consumption of animal fats and marine oils increased at a rate far below that for vegetable oils. Within the group of vegetable oils the composition of demand changed in response to availabilities of the various oils and to a number of economic and non-economic factors affecting the use of oils.

5. The shift of demand away from animal fats and oils and to vegetable oils is expected to continue. This will strengthen the markets for vegetable oils as a group. Increasing interchangeability among these oils will tend to reduce price differences in the long run. In the short run, however, prices will still reflect relative availabilities of individual oils. According to Bank projections, world demand for all fats and oils at 1972 prices will rise to 56 million tons in 1980. This is 31.5% more than in 1970 (42.6 million tons) and represents a somewhat slower rate of increase than in the preceding decade (33.1%). World consumption of vegetable oils in 1980 is expected to reach about 39 million tons (69.5% of the total), an increase of 41% over 1970.

6. During the past decade world production of animal fats and marine oils has increased more slowly compared to the output of vegetable oils. Within the group of vegetable oils, soybean oil, palm oil, rapeseed oil and sunflowerseed oil showed steepest increase. On the basis of past production trends, world supply of all fats and oils combined in 1980 is expected to be roughly in balance with world demand at the level of 56 million tons of oil or fat equivalent. This in turn implies that increased supplies of fats and oils will be absorbed in the market without any persistent downward pressure on the prices of these commodities as a group.

7. On the basis of present estimates of future output of the different commodities involved, it seems clear that palm oil will account for a larger increase in world demand for vegetable oils than in the 1960-1970 decade. Total demand for palm oil is expected to reach 4,130 thousand tons in 1980 compared with 2,078 thousand tons in 1971. Slightly more than half of this quantity will be absorbed by developed countries, compared to 42% in 1971 and 35% in 1967. Total output of palm oil is projected to reach between 4,080 and 4,230 thousand metric tons (depending on alternative production forecasts for Malaysia). Exports will range between 2,535 and 2,685 thousand metric tons (Table 1). This corresponds to about 63% of the total production compared to 48% in 1971 and 49% in the period 1967 - 69. Malaysia will dominate exports, followed by Indonesia; the Ivory Coast and Zaire will be the only important exporters in West Africa, although Dahomey will expand its markets further. The share of developing countries in total consumption will fall from 57% in 1971 to 48% in 1980, but the share of intra-developing countries trade in total exports will increase from 10 to 18% (low output assumption).

8. The following factors will affect the future price of palm oil. World consumption of palm oil is projected at 4,130 thousand metric tons in 1980; 1,520 metric tons will be consumed domestically in producing countries. This leaves a total import requirement of 2,610 thousand metric tons, of which 14% would come from non-producing developing countries and 4% from Nigeria, which is expected to become a net importer of palm oil in the amount of 130 thousand metric tons. Output is projected to reach between 4,080 and 4,230 thousand metric tons, depending on developments in Malaysia. The 150 thousand ton supplement in the higher projection for Malaysia is expected

to find its way into exports, giving alternative world export figures of 2,535 to 2,685 thousand tons. The projected difference between import demand and export supply is small and, given the expected overall balance between demand and supply of all fats and oils of vegetable oils. The price for palm oil is projected at 495 US dollars per metric ton (in 1980 dollars). Taking into account a rate of inflation forecasted (1974 = 100 and 1980 = 165), the price for palm oil will be about 300 US dollars per metric ton in 1974 constant terms.

9. Table 2 contains monthly prices for palm oil (Malayan, bulk, 5%, cif European ports) for the period from 1967 to 1973. These figures illustrate the dramatic increase in palm oil prices in more recent years. From 1967 to 1973 annual average prices increased at a rate of 10.9% - well above the average rate of inflation in developed countries. In August and September 1974 prices were at record levels and prices of over US$700 per metric ton were quoted for palm oil.

B. Market Prospects for Palm Oil in Nigeria

Past Trends in Production

10. During the early sixties Nigeria was one of the world's leading producers and exporters of palm oil and palm kernels, accounting for about 40% of total production and nearly 3% of world trade. However, during the period from 1960-1966 annual production remained more or less stagnant. The civil war (1966-1970) took place mostly in the heart of the palm belt of Nigeria which adversely affected the oil palm industry. Many palm areas (wild groves and estates) and processing facilities were then destroyed, large palm areas were cleared for emergency food production and the whole socioeconomic framework of oil palm production and marketing was disrupted. Since the cessation of the hostilities, production has been increasing but has not yet attained the pre-war level. Thus, stagnant production and a growing domestic demand has substantially reduced Nigeria's commercial surplus (Table 3).

11. The major palm producing areas of Nigeria are located in the Western, Mid-Western, East Central, South East and the Rivers States. Apart from the production from some commercial estates, farm settlement and rehabilitated groves, the bulk of the supply of palm products comes from the wild groves. Reliable data on total production are not available and there is considerable variation in the estimates of total production. For example, the United States Department of Agriculture's (USDA) pre-civil war estimates put 1960-1966 annual average production at about 546,000 tons. An FAO study for the same period estimates the total quantity at 20-50,000 tons lower than this figure. The Nigerian Federal Ministry of Agriculture has estimated

production at a level which is about 200,000 tons higher than the USDA estimate. Palm oil production is currently estimated to be about 550,000 tons. The bulk of this production comes from the wild palm groves which cover an area estimated at about 2.4 million ha.

Utilization of Palm Produce

12. There are basically three sources of demand for palm products in Nigeria:

(a) for household consumption in the preparation of food;

(b) for the production of soap, margarine and other such related products; and

(c) for export.

13. Large quantities of palm oil produced in Nigeria are used for direct domestic consumption, both for cooking and frying. It is cheaper than its nearest substitute, groundnut oil. For example, in the Southern States, prices of palm oil are about 60% lower than groundnut oil, and in the Northern States prices differ by about 25%. However, with increases in income levels, Nigerians appear to substitute a part of their use of palm oil (particularly for frying) with groundnut oil. A rural household survey 1/ conducted by the Federal Ministry of Statistics indicates that the average per capita annual intake (1963/64 and 1965/66) of fats and oils in Nigeria was around 9.1 kg of which about 8.1 kg (about 89%) was palm oil. There are, however, wide regional variations (about 2.3 kg in the Northern States, 11.4 in the Eastern States) and the above figure represents a weighted national average (Table 4). Using this average quantity and assuming 89% of the total population to be effective consumption units, consumption of palm oil by households in Nigeria is estimated at an annual average of about 413 thousand metric tons for the period 1962-1966.

14. Domestic industrial consumption of palm oil in Nigeria (as measured by Marketing Boards' domestic sales) average about 12,000 metric tons per annum during 1962-1972, which is about 2% of the total annual production of this period and as such, represents a minor source of product utilization (Table 5).

15. During the early sixties Nigeria used to export more than 20% of its total palm oil production (Table 6). However, a rapidly growing population (rate of growth over 2.6%), increases in per capita real income and a positive, although less than unitary, income elasticity of demand has resulted in a steady upward shift of the demand function and consequent reduction in net commercial surpluses. Export trade was virtually terminated

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1/ Rural consumption inquiries: Food Items, Federal Office of Statistics, Logos.

during the civil war years and since then annual exports have fluctuated between 2,000 - 20,000 metric tons. In sharp contrast to a total export of 200,000 metric tons in 1953 - 1954, Nigeria shipped only about 2,000 tons in 1972.

16. Production of palm kernels, as measured by Marketing Boards' purchases, has averaged about 416 thousand metric tons during the five pre-war periods (Table 7). Before 1965 roughly about one percent of this quantity was crushed in Nigeria and the rest were exported. However, since 1965 several palm kernel crushing mills have been established and domestic utilization of kernels had increased to about 71 thousand tons in 1970 as opposed to about 3,000 tons in 1962. Increases in the palm kernel crushing facilities have also led to increases in the export of palm kernel oil - from a mere 3,000 tons in 1963 to about 33,000 tons in 1970 (Table 8).

Future Prospects

17. The supply of palm oil suffers from certain inflexibilities that are inherent in tree crops. For example, it has a relatively long gestation period between planting and harvesting and its output cannot be changed from year to year. Nearly 90% of the present supply of palm oil produced in Nigera comes from the wild groves. However, exploitation of wild palms had reached a maximum level in the mid-1960s and any improvements in future extraction rates through the introduction of more efficient processing will be largely offset by decreased production of fruits as the trees age and become increasingly difficult to harvest. Production may also be depressed by the felling of wild palms to clear land for food crops as population densities increase in the Southern States.

18. As such, the scope for increasing the production of palm oil from the existing sources is limited and is therefore dependent upon the successful implementation of new planting and replanting programs. Prior to 1966 some plantings of improved palm on estates, farm settlements and rehabilitated groves had been initiated, but in Eastern Nigeria the program was halted during the civil war. The study group on oil palm of the National Agricultural Development Committee estimates in its report (June 1972) that until 1971/72 about 162,802 ac (66 thousand ha) of palm had been improved. Taking all such developments into consideration, it is estimated that total domestic production from existing plantings, including the improved palm planted before the civil war, will average about 570,000 tons per annum during 1975-1980. Of this quantity, nearly 515,000 tons are expected from wild palm groves and about 53,000 tons from improved palms.

19. Domestic consumption of palm oil and kernels will continue to increase over the next decade. Based on an expected population growth of 3% per annum from 1975 to 1980, projected per capita income growth of 3% and income elasticity coefficient of 0.5, domestic household consumption of palm oil is expected to increase by about 4.5% per annum, reaching about 690,000 metric tons in 1980, or about 8.8 kg per capita. During the early

1980s, per capita consumption is expected to level off, with total consumption growing at about 3.25% per annum and reaching about 810,000 metric tons in 1985 (Table 9). If we take into consideration an industrial demand for about 10 - 15,000 tons of palm oil per annum, the total domestic demand in Nigeria would be about 702,000 metric tons in 1980 and 825,000 metric tons in 1985.

20. Projected growth of supply and demand of palm oil in Nigeria is presented in Table 10. It shows that by the years 1980 and 1985, there will be a net deficit of about 130,000 and 275,000 metric tons respectively. Unless an extensive program of planting/replanting using improved planting materials is initiated in the mid-1970s, Nigeria faces the prospect of becoming a major importer of palm oil. Assuming an average output of 2.20 metric tons of oil per ha for smallholdings (10 tons of ffb with an extraction rate of 22%), it would be necessary to bring about 125,000 ha of land under improved palms in order to be able to meet the projected shortfall of about 275,000 metric tons. The projects being appraised involve planting about 42,000 ha which at full development in the late 80s would produce about 100,000 tons of palm oil. These projects are Phase 1 of a program ultimately scheduled to plant/replant about 75,000 ha in Western, Mid-Western, and East Central States by 1982/83. Though extensive, these planting programs will not meet the projected shortfall in palm oil supply during the mid 80s. If, however, effective new planting/replanting programs can also be implemented in the other main oil palm areas of South East and Rivers States, and a planned estate development program materializes in East-Central State, the supply shortfall should be considerably reduced.

C. Marketing Institutions

Marketing Boards

21. Nigeria's major agricultural exports - cocoa, groundnuts, palm produce - and a number of other commercial crops 1/ are marketed through 6 State Marketing Boards 2/ and through their export sales outlet, the Nigerian Produce Marketing Company (NPMC). Major commodities not controlled by Marketing Boards are rubber and food crops. The original objectives of these Boards, which were established during World War II, 3/ were to stabilize prices for farmers and to improve the organization of marketing. The Boards were charged

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1/ Benniseed (sesame), coffee, copra, cotton, grapefruit, kenat, sheanut and soybeans.

2/ The Western, Mid-Western, East Central, South East, Rivers and Northern States Marketing Boards.

3/ For historical details see Report 282a-UNI, Appraisal of Second Cocoa Project, Nigeria.

by law with responsibilities for fixing the producer prices of these crops, 1/ buying the marketed surplus from the growers and arranging for packaging, storage, handling and transportation to the port of shipment.

22. Each year the Marketing Boards announce Marketing Schemes for individual commodities wherein the list of gazetted buying stations, the Licensed Buying Agents (LBA) are specified. The LBA's act on behalf of the Boards in purchasing, grading, storing, packaging and transporting the produce and are responsible for losses and/or damage (resulting from theft, pilferage, defective packaging and such other reasons) incurred from the time of purchase to the time of delivery into the Boards' designated warehouses. All products bought by the Buying Agents, however, have to be graded and approved by the Produce Inspection Division of the State's Ministry of Trade. In return for their services, the LBA's are paid block allowances. However, Marketing Boards have no effective control over the prices paid by LBA's to farmers who often consider that they are being exploited by them.

23. Since the 1960s the Marketing Boards have acted as convenient instruments for transferring resources from Agriculture to the State Exchequers, most of the trading profits being channelled into various government departments in the State and very little spent on the development of the enterprises that produced the products. The Boards have also been obliged to subsidize certain nonviable enterprises which have added to overhead costs; for example, the Boards have to charge the total running expenses of the States' Produce Inspection Division to their produce trading accounts. These Divisions have grown despite the decline in export volume. Further, the Bulk Oil Company, owned by NPMC, debits its full operational costs to the Boards despite very low utilization of the facilities by the latter. In addition to such payments, surplus Marketing Board revenues have been invested in Government securities, thereby diverting agricultural revenues away from the agricultural sector.

24. On the other hand, all through this period, the producer prices paid to the farmers were much lower than the actual FOB prices received by the Boards (Table 11). The pricing policy followed has not reflected local price conditions. While Nigerian domestic prices for palm oil are about three times their pre-war level, the producers' prices fixed by the Marketing Boards have not been given adequate upward revisions. For example, the average wholesale price of palm oil during 1973 (January - October) was about ₦ 220 per ton as opposed to ₦ 100 offered by the Boards. Consequently, smallholders choose to sell their surplus to the local markets rather than to the Boards and this has limited the Boards' purchases primarily to the output from a few small estates owned by the State governments and from some of the smaller palm oil mills.

1/ The Marketing Boards have now been diverted from the power to fix producer prices (see para 32).

25. By the provision of law, all processors of palm oil and palm kernels are required to sell their produce directly to the Marketing Boards. These provisions have, however, been relaxed in recent years and now entities like the Oil Palm Company (OPC), 1/ the Agricultural Development Authority (ADA), 2/ the Agricultural Investment Corporation (AIC) 3/ and NIFOR are allowed to sell palm oil and kernels in the domestic market, as well as directly to the NPMC.

26. Most of the State Marketing Boards are now financially weak due to a combination of (a) increasing costs per ton of product handled resulting from declining produce sales and the Boards' failure to contract their administrative structures proportionately, (b) inefficiencies and (c) direct and indirect taxation.

Western Nigeria Marketing Board

27. In September 1954 the Western Nigeria Marketing Board was established and its area of operation included what is now Mid-Western State. In 1963 it was split up into the Western State Marketing Board (WSMB) and the Mid-Western State Marketing Board (MWSMB). Quantities of palm oil and palm kernel handled by the WSMB are given below.

Palm Produce Handled by Western State Marketing Board 1969-73
(thousand metric tons)

Years	Palm Oil	Palm Kernels
1964	1.8	147.8
1965	2.0	162.6
1966	2.0	172.7
1967	1.0	144.3
1968	0.7	140.2
1969	0.7	138.2
1970	0.6	134.1
1971	1.0	121.9
1972	0.5	93.9
1973 /1	0.5	70.6

/1 Up to August.

Since 1967 the WSMB has not purchased any significant quantities of palm oil while the quantities of kernels handled in 1973 were about 52% lower than that in 1964. During 1972 it employed 163 LBA's for the purchase of

1/ In the Mid-Western State

2/ In the East-Central State

3/ In the Western State

palm kernels and had only one for palm oil. The Board has not purchased any palm oil from the producers in recent times. The Agricultural Investment Corporation (AIC), which owns three plantations and processing facilities, is the main supplier of palm oil to the Marketing Board. However, because the Marketing Boards' prices are lower than the free market price, AIC has been bypassing the Boards and selling most of its output to the wholesale (60%) and retail (40%) outlets. Fifty percent of the kernels handled by the Western State Marketing Board are sold to the local processors (Vegetable Oil Mills, Lever Bros., etc.) and the balance is forwarded to the NPMC for export. The Board's palm oil trading account has sustained a net trading loss since 1964-65 and its kernel trading account since 1969-70.

Western State Marketing Board

Palm Produce Trading Account 1964/65 - 1971/72
(million Naira)

	Palm Kernels	Palm Oil	Total	All Commodities
1964/65	3.75	- .010	+ 3.74	- 5.8
1965/66	3.90	- .006	+ 3.85	+ 8.6
1966/67	--	--	--	--
1967/68	3.22	- .002	+ 3.21	+25.2
1968/69	--	--	--	--
1969/70	1.72	- .022	- 1.71	+26.2
1970/71	- 2.46	- .008	- 2.47	- 2.34
1971/72	- 3.46	--	- 3.46	--

Mid-Western State Marketing Board

28. Prior to 1963 the Western Nigeria Marketing Board used to handle the scheduled export crops produced in what is now the Mid-Western State. In 1963 the Mid-Western State Marketing Board (MWSMB) was created by splitting up the parent organization (see para 27). Details of the Board's palm kernel and palm oil operation are given below:

Palm Produce handled by Mid-Western State Marketing Board 1964 - 1972
(thousand metric tons)

Year	Palm Oil	Palm Kernels
1964	7.3	39.8
1965	8.7	43.9
1966	7.1	41.4
1967	4.7	32.2
1968	3.9	44.1
1969	2.4	37.2
1970	2.8	51.0
1971	3.0	28.7
1972	2.2	23.2

From the figures it is clear that since 1963-64 MWSMB has been handling diminishing quantities of palm produce. During 1969-70, the Board had a net trading deficit on the palm produce account. The Oil Palm Company and NIFOR have been its major suppliers of palm oil, but both are now selling directly to the domestic market also. There are, however, some cooperative marketing unions which act as Licensed Buying Agents for the Board. Because the Marketing Board's purchase prices have been lower than the prevailing market prices, it has not been able to acquire any significant quantities of palm oil in recent years. MWSMB is currently planning to establish its own oil palm plantation and processing facilities. With this in view, about 5,000 ac of land has been cleared near Okhuo, 22 miles north of Benin, and management negotiations are in progress with the NIJAL.

Mid-Western State Marketing Board

Palm Produce Trading Account 1963/64-1969/70
(million Naira)

Year	Palm Kernels	Palm Oil	Total
1963/64	0.19	0.05	0.24
1964/65	0.51	0.13	0.63
1965/66	0.41	0.03	0.44
1966/67	0.19	0.02	0.21
1967/68	0.49	-0.07	0.42
1968/69		-	-
1969/70	-0.05	-0.07	-0.12

East Central State Marketing Board

29. East Central State Marketing Board came into existence in 1970 when the former Eastern Nigeria Marketing Board was split into East Central, South Eastern and Rivers State Marketing Boards. The East Central State Marketing Board has been facing financial difficulties. During 1972 it had a net trading deficit of ₦ 1.5 million on the produce account and a total deficit of about ₦ 2.00 million including all products handled. It operates through a system of Licensed Buying Agents (LBA) and during 1973 it employed about 100 LBA's for palm oil purchases, about 200 for palm kernels and about 30 for cocoa. Details of the quantities of palm oil and palm kernels handled by the Board are given below:

Palm Produce handled by East Central Marketing Board 1970-1973
(thousand metric tons)

Year /1	Palm Oil	Palm Kernels
1970	1.4	14.9
1971	12.1	84.4
1972	4.3	76.9
1973 /2	0.1	49.3

/1 Data for earlier years have been destroyed.

/2 Up to November 15.

From the figures it is clear that the East Central Marketing Board is handling diminishing quantities of palm oil and palm kernels. The Agricultural Development Authority (ADA) now bypasses the marketing board and is engaged in oil palm processing and palm produce marketing. Currently it runs about 20 rehabilitated Pioneer Oil Mills, wherein fruit bunches collected from smallholders are processed. It also purchases palm oil from free markets at prevailing market prices and after packaging them in 44-gallon drums, sells them to bulk purchasers. During the period April 1972 to September 1973, the ADA oil palm unit handled about 2,200 tons of palm oil and 1,200 tons of kernels. Almost all its sales are to soap, margarine and allied production enterprises in Nigeria.

Nigerian Produce Marketing Company (NPMC)

30. Scheduled crops which are handled by the Marketing Boards, when exported, are shipped and sold exclusively by the NPMC which acts as export agent for the different Marketing Boards. From the total sales proceeds various expenses incurred on overseas shipping of the produce (such as handling at the port, wharfage, lighterage, bulking charges, insurance, export duties, freight charges, etc.) plus an agency fee (which currently is assessed at ₦ 4.00 to 6.00 per ton) to cover its own establishment expenses are deducted and the balances are remitted to the respective Marketing Boards. The NPMC has several produce departments (cotton, palm produce, groundnuts and cocoa) and owns the Bulk Oil Company which handles palm oil. Like the Marketing Boards, the NPMC also has not adjusted its fixed administrative expenses to the changed revenue situation created by a declining volume of business. This has resulted in high costs per ton of product handled and weakened the financial position of the company.

Future Role of Marketing Institutions

31. The past performances of the State Marketing Boards, particularly the principles under which they operate, have been facing adverse criticisms in recent years. In early 1973 the FMG announced certain reforms in the

Government's policies on the marketing of export commodities. The details of the decree announcing the proposed reforms have not yet been made public However, the following appear to be the main elements of a new policy that is under consideration:

(a) The Nigerian Produce Marketing Company, exclusively taken over by the FMG will be the sole owner of all scheduled export crops (cocoa, cotton, benniseeds, soybean, groundnuts and palm products). It will also assume responsibilities for the domestic sales of these commodities to local processors. The State Marketing Boards will exist as the principal buying agents for the NPMC and will be responsible for purchasing, handling, grading, storage and delivery of the scheduled crops to the NPMC warehouses. They will be entitled to get loans from the Central Bank to finance their operations but neither the NPMC nor the Marketing Boards will be allowed to build up financial reserves. The Marketing Boards will retain their present system of Licensed Buying Agents for handling the local purchases.

(b) Estates and large producers will be permitted to bypass the Marketing Boards and sell directly to NPMC.

(c) The State Marketing Boards will be divested of the powers to fix producer prices. Instead, producer prices will now be fixed by the Head of the FMG, assisted by a Technical Committee on producer prices. The Technical Committee, headed by the Permanent Secretary of the Federal Ministry of Finance, consists of the General Managers of all the State Marketing Boards, two representatives from the Central Bank, Permanent Secretaries of the Federal Ministries of Trade and Economic Development, and representatives from the NPMC. The Technical Committee would have subcommittees for each of the commodities handled. The subcommittees would make recommendations which would then be forwarded to the Head of FMG as the recommendations of the Technical Committee. It should be noted that these recommendations would not be binding on the Head of the FMG, who could overrule them and take his own decision. Each year two sets of prices will be announced by the Technical Committee: the producer prices to be paid by the Marketing Board and the NPMC take-over prices (which will be a common price for the same commodities irrespective of its origin). Producer prices will be directly related to the FOB prices. They will present a net of FOB prices after deducting all expenses and commissions. The FOB prices will be calculated on the basis of an average of the previous shipping periods and adjusted by projected domestic and world supply and demand conditions. The FMG has given assurances that irrespective of whatever adverse changes may take place in world prices, producer prices will be maintained at the announced level during the particular season, if necessary even through Government subsidies.

(d) Under the new marketing reforms there might be a provision requiring domestic processors of scheduled commodities to purchase their raw materials from NPMC and at FOB prices.

(e) All export duties on Marketing Board products have been abolished with effect from April 1973. Produce sales tax and export duties were merged into a single 10% ad valorem produce tax to be levied on the producer price and paid to the pertinent State governments. However, early in 1974 FMG announced in its budget message that the 10% sales tax on agricultural products would be abolished.

32. Producer prices for all scheduled crops, except palm oil and kernels, have been announced for the 1973-1974 shipping period (cocoa ₦ 400.00 per ton, benniseed ₦ 110.00 per ton, soybean ₦ 50.00 per ton and groundnut ₦ 94.25 per ton). Early in 1974, in the budget message for 1974/75, FMG announced new prices: cocoa ₦ 450 per ton; groundnuts ₦ 165 per ton; cotton ₦ 201 per ton and palm kernels ₦ 132 per ton.

Implications of Future Marketing Policies

33. No full assessment can be made of the proposed marketing reforms until FMG issues the new decrees and specifies the crops over which NPMC will have regulatory powers. At present hardly any palm oil is exported from Nigeria and according to the projected demand and supply conditions, palm oil output from the projects will easily find a ready market within Nigeria. The project does not envisage at this juncture going into kernel crushing and therefore kernel output from the project would be either sold for export or sold to domestic producers for further crushing.

34. The marketing of palm products in Nigeria has changed fundamentally. Palm oil for all practical purposes is no longer an export commodity, though kernels still can be regarded as such. NPMC's main objective is towards the regulation of producer prices of export crops.

35. The projects are aimed at reducing the shortfall of domestic supply of palm oil. However, if the central processing companies are to operate efficiently, their throughput will need to be maintained at the capacity levels projected; to achieve this, they must be in a position to offer smallholders prices that are competitive with local markets. Therefore, the oil palm companies should be free, as they are at present, to sell their palm oil on the domestic market at prices determined by the local market forces.

D. Pricing Policy for the Purchase of Fresh Fruit Bunches

Price Policy Committee

36. A price policy committee would be appointed in each State 1/ and would comprise:

1/ Western State, Mid-Western State, and East-Central State.

(a) Permanent Secretary of Ministry of Finance - Chairman;

(b) Permanent Secretary of Ministry of Agriculture;

(c) Registrar of the Cooperative Societies or his representative;

(d) General Manager of the Company 1/ or a senior representative;

(e) General Manager of SMU (TCU) - Secretary;

(f) Representative of the Marketing Board;

(g) Two representatives of smallholders;

(h) Representative of NPMC; and

(i) Such other members as the State Governments may decide. 2/

The committee would establish the principles to be applied in determining the price to be paid for ffb by the Companies' central mills when purchasing fruit from participating smallholders. They would determine a purchasing price formula which the Companies would be obliged to apply in calculating the price they would pay for ffb. Using this formula the mill, from month to month, or other suitable time span, would announce a price to be paid for ffb. Any departure from this formula would be referred back to the Committee prior to implementation. The following factors would be taken into account by the Committee in determining the purchasing price formula.

Price Calculation

37. The price paid per ton of ffb would be determined from the revenue received for the palm oil and kernels produced from a ton of ffb after allowing for the costs of fruit collection and processing, including depreciation, taxes and financial charges. The financial charges would be adequate to provide a reasonable return on the required capital investment, which would be sufficient to cover interest charges, and margins for building up reserves and paying dividends to the Company's shareholders. The return on capital would be measured on the basis of a percentage of net revalued fixed assets plus a reasonable allowance for working capital; this percentage would be agreed by the price policy committee within a suggested 10% - 15% range. Depreciation on fixed assets would be taken on a straight line basis for short-lived assets, such as those used for fruit collection; for longer lived assets, such as the mill, it is suggested that a more appropriate basis would be an

1/ Western Oil Palm Company (WOPC), Western State; Oil Palm Company (OPC), Mid-Western State; Agricultural Development Authority (ADA), East-Central State.

2/ See respective appraisal reports.

allocation over output processed compared to the estimated processing capacity of the mills over their estimated remaining useful life. Having deducted these costs, calculated on a cost/ton basis, from the revenue received from the sale of one ton of produce, the price per ton of products net of all costs is known. This would be the base price.

38. Applying the appropriate extraction rate of products to bunches to this base price the price per ton of ffb can be calculated. Extraction rates applied would be related to the mill's previous three months processing results with all participants receiving a price based on an overall average extraction rate. Whilst this means that producers with more mature trees would be receiving slightly lower extraction assessment than might be justified, on balance, the application of a standard extraction rate is considered to be more practical from an operational standpoint.

39. Any profits in excess of the agreed return on capital would be distributed to the smallholders in the form of a cash bonus at the end of, say, each half-year. The amount paid to the individual smallholders being proportional to the quantity of fruit sold to the company over the period concerned.

Grading

40. Having determined an ffb purchase price for Grade 1 fruit (suitable stage of ripeness of tenera bunches) discount rates would need to be determined and agreed with producers in order to take account of:

(a) under and over-ripe bunches;

(b) excessively long stalks;

(c) bunches having dirty fruits, stones, mud, etc.; and

(d) fruits from wild palm groves or dura material having a lower oil content.

Due to the fact that the mill would not have a captive market, prices offered at any time must be competitive with bids prevailing in the areas from which produce is being purchased, and hence the minimum price paid for ffb will be determined by prices prevailing in the local market for similar fruit. Hence it seems reasonable to assume that when deriving a price per ton of ffb, the central mill could apply a combination of:

(a) its own short-term selling price, say, a three-month average from which it calculates a base price and hence an ffb price per ton; and

(b) short-term trends in the local markets.

In the short-run, the mill may sustain losses in order to compete with local market conditions. To anticipate changes in local market conditions, a monthly index (adjustment factor) could be applied either to the base price or to the ffb price calculated from the base price.

E. Calculation of Economic and Financial Millgate Prices for Palm Oil and Kernels

41. For the purpose of this project the economic and financial prices for palm oil and kernels have been calculated using the world market price projections for 1980 by the Bank's Economic Analysis and Projections Department (see Tables 12 and 13).

Palm Oil

42. It has been assumed that without the proposed projects Nigeria would be a net importer of palm oil by 1980. The projections indicate that by 1985 the net deficit would be around 275,000 tons of palm oil and most of this deficit would have to be supplied from Malaysia. The Ivory Coast would be able to supply part of this deficit but it is unlikely that the cif price would be much below the Malaysian price. It has further been assumed that palm oil imported or produced by the project would be sold in or around the large urban markets of Western Nigeria, such as Ibadan. Implicit in this assumption is that the other urban and rural markets in Nigeria would be fully supplied from alternative sources. It is probably, however, that the areas would also be the markets for the project and this would result in higher economic and financial millgate prices since (a) the transport from port to the market would be higher, and (b) the transport from the mill to the market would be less than projected with Ibadan as the market. Hence the price estimates tend to be on the conservative side. Furthermore projects would be in full production after 1985 and the forecasted price for 1985 in constant 1974 terms is substantially higher than the 1980 price.

Kernels

43. For the purposes of the economic and financial millgate prices it has been assumed that kernels will be exported at a projected 1980 price of US$330 per metric ton. The charges included are based on what is currently expected to be the role of the Marketing Boards and NPMC, where the Mill can bypass the Marketing Board and sell directly to NPMC and hence avoid any Marketing Board commission.

44. With the rapid expansion of kernel crushing industries from 2 mills at present, with a combined crushing capacity of 110,000 tons per annum, to about 7 - 9 mills with a capacity of 350 - 400,000 tons, provided all presently projected investment programs materialize (nearly all joint enterprises with State participation), it is probable that a large proportion of kernels

would be processed locally and exported as kernel oil. In that case the export price for kernel oil would be obtained and given efficiency in the crushing operations the added value for Nigeria would be higher. Therefore taking the export prices for kernels is again a conservative estimate.

NIGERIA

OIL PALM PROJECTS

Palm Oil, World Production, Exports and Consumption, Actual and Projected

(In thousand metric tons)

Countries and Areas	Production		Exports	
	1971	1980 projected	1971	1980 projected
Malaysia /1	588	1,970-2,125	572	1,910-2,060
Indonesia	225	475	190	375
Nigeria	500	575	20	(130)
Zaire	200	235	112	75
Other countries in Africa	410	685	68	205
Rest of the world	85	140	3	100
World	2,008	4,080-4,235	965	2,535-2,685

	Consumption	
	1971	1980 projected
Developed countries	878	2,100
Centrally planned economies	6	50
Developing countries:	1,194	1,980
of which		
(a) non-producing	90	360
(b) producing	1,104	1,620
World	2,078	4,130

Note: Price of Malaysia palm oil CIF Europe (in US dollars per metric ton)

	1972	1973	1974 3/	1980 projected	1985 projected
Constant '74 prices	$286	$425	$710	$300	$327
Current prices	$217	$378	$710	$495	$757

Share of palm oil in world output of all fats and oils

1971	1980 projected
4.88 percent	7.32 percent

1/ Alternative output forecasts depending on realization of production plans.

2/ Ivory Coast, Dahomey and Cameroon only.

3/ Partly estimated.

NIGERIA

OIL PALM PROJECTS

Prices for Palm Oil (Malayan Bulk, 5 percent, cif European Ports

(US$/metric ton)

	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Annual Average
1967	200.8	197.6	191.3	191.3	191.9	196.6	196.1	196.1	192.0	190.4	187.2	191.3	193.6
1968	184.2	185.4	188.5	189.3	186.2	172.2	-	-	-	135.8	135.8	-	172.2
1969	-	-	179.5	170.1	166.3	165.3	161.8	171.5	181.0	203.9	-	255.1	183.8
1970	255.3	256.3	259.0	267.5	278.7	276.0	266.3	242.4	175.7	249.9	269.9	271.6	255.7
1971	278.4	283.0	280.7	273.9	248.0	242.9	268.7	284.8	273.9	254.0	247.9	236.2	264.4
1972	224.2	185.3	214.2	226.7	227.6	203.6	214.1	220.5	222.7	219.0	218.8	213.7	215.9
1973	213.9	264.1	278.7	290.7	328.2	372.8	455.9	532.0	-	437.7	420.7	-	359.5

Supplement 12
Table 2

NIGERIA

OIL PALM PROJECTS

Estimated Production of Palm Oil in Nigeria 1960-1972

(thousand metric tons)

Production	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Commercial	190.1	173.4	128.5	149	147.9	164.2	158	32	4.2	22.6	25.0	30.9	20
Subsistence	355	365	376	387	398	410	422	288	322	395	463	489	490
Total	545.1	538.4	504.5	536	545.9	574.2	580	320	326.2	417.6	488	520	510
% World	44.7	42	39.5	39.8	39.8	42.6	41.9	25.4	22.9	23.7	27.7	25.9	-
% Africa	56.2	52.9	50.4	51.7	52.1	57.6	59.6	39.7	36.5	44.1	46.7	46.8	-

Source: US Department of Agriculture.

1971 Commercial figure: Statistical Information on Western Nigeria Controlled Produce No. 8, Statistics Division, Western Nigeria Marketing Board.

1972 figures: Central Bank, Monthly Report.

NIGERIA

OIL PALM PROJECTS

Per Capita Weekly Consumption of Fats and Oils by States, 1963/64 and 1965/66

(lbs)

Fats and Oils	North Central	North Eastern	North West.	Kano	Benue Plateau	Kwara	West	Lagos	Mid-West	South East	Rivers	Central	All Nigeria Weighted a.m.
Palm Oil	0.20	0.21	0.09	0.01	1.21	0.05	0.48	0.55	0.48	0.42	0.41	0.42	0.36
Groundnut Oil	0.03	0.04	0.02	*	-	0.10	*	*	0.01	*	0.01	*	0.02
Melon Seed Oil	-	-	-	-	-	-	*	-	*	*	*	*	0.004
Sheer Butter	-	-	-	-	-	0.14	*	-	-	-	-	-	0.008
Butter	-	0.03	-	-	-	-	*	-	*	-	-	-	0.006
Margarine	-	-	-	-	-	-	-	-	-	-	-	-	-
Coconut Oil	-	-	-	-	-	-	*	-	0.01	-	-	-	0.002
Other Oils	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: * = less than 0.005; - = not consumed.

Source: Rural Consumption Inquiries, Food Items, Federal Office of Statistics, Lagos.

NIGERIA

OIL PALM PROJECTS

Utilization of Palm Oil by Local Producers in Nigeria, 1962-72

(Thousand metric tons)

Year	Quantity /1
1962	16
1963	13
1964	13
1965	7
1966	7
1967	6
1968	4
1969	11
1970	10
1971	15
1972	18

1/ Average 1962-1972 12,000 metric tons.

Source: Marketing Boards

Supplement 12
Table 6

NIGERIA

OIL PALM PROJECTS

Nigeria Quantities of Palm Oil Exported 1960-72

(Thousand metric tons)

	Exports		Production		Exports as % of Production 1/
	Total	5 yr. Moving Av.	Total	5 yr. Moving Av.	
1960	189		545		
1961	181		538		
1962	120		505		
1963	128		536		
1964	136	151	546	534	28.3
1965	152	143	574	540	26.5
1966	146	136	580	548	24.8
1967	17	116	320	511	22.7
1968	4	091	326	469	19.4
1969	23	068	418	443	15.1
1970	9	040	488	426	8.9
1971	20	015	520	414	3.2
1972	2	012	510	452	2.2

1/ Based on the 5-year moving average figures

Source: Federal Office of Statistics, Lagos

NIGERIA

OIL PALM PROJECTS

Nigeria - Palm Kernel Production and Utilization 1962-73

(Thousand metric tons)

Year	Production	Domestic Sales		Exports	
		Quantity		Quantity	
1962	368	2.6		377	
1963	422	2.7		390	
1964	407	2.9		400	
1965	456	5.1		417	
1966	424	77.6		372	
1967	223	71.6		152	
1968	193	65.9		161	
1969	235	72.4		186	
1970	295	7.5		190	
1971	307	...		248	
1972	269	...		220	
1973 2/	...	...		40	
Averages:		Quantity	%/1	Quantity	%/1
1962-1966	416	18	4.4	391	94.2
1967-1972	254	71	30.0	193	76.0
1962-1972	327	42	13.0	283	87.0

1/ percentage of production
2/ up to August 1973

Source: Marketing Boards

NIGERIA

OIL PALM PROJECTS

Nigeria - Export of Kernel Oil 1963-70

(Thousand metric tons)

Year	Quantity
1963	3.3
1964	.9
1965	1.0
1966	33.1
1967	38.4
1968	27.7
1969	37.9
1970	33.2

Averages

1963-1966	9.6
1967-1970	34.3
1963-1970	21.9

Source: Marketing Boards

NIGERIA

OIL PALM PROJECTS

Nigeria - Estimates of Demand for Palm Oil 1975-1985

Year	Population 1/	Consumption Unit 2/	Demand 3/
	--(Million persons)--		(Million tons)
1975	75.8	67.5	.554
1976	78.1	69.5	.579
1977	80.4	71.6	.605
1978	82.8	73.7	.632
1979	85.3	75.9	.661
1980	87.9	78.2	.690
1981	90.5	80.5	.712
1982	93.2	82.9	.736
1983	96.0	85.4	.759
1984	98.9	88.0	.784
1985	101.9	90.7	.809

1/ Assuming 3 percent growth per annum.
2/ 89% of total population taken to be effective consumption units.
3/ per capita consumption demand in 1975 estimated at 8.1 kilograms, after which rate of growth in demand estimated at 4.5% per annum until 1980 and after that 3.25% per annum.

NIGERIA

OIL PALM PROJECTS

Actual and Projected Growth in Demand and Supply for Palm Oil 1975-1985

(Thousand metric tons)

Demand	1960	1965	1970	1975	1980	1985
Households	350	415	469	554	690	810
Processors	6	7	10	12	12	15
Total Demand	356	422	479	566	702	825
Supply						
Existing palms	545	574	488	570	570	550 1/
Surplus/(deficit)	189	152	9	4	(132)	(275)

1/ Based on assumption that production from wild palm groves will decline.

Source: Actual figures: Federal office of Statistics, Lagos.
Projected figures: Mission estimates assuming no new planting or replanting.

NIGERIA

OIL PALM PROJECTS

Producer and FOB Prices of Palm Produce 1963 - 1973

(Naira per ton)

Years	FOB Prices			Producer Prices				
	SPO	TPO	Kernels	SPO /1	TPO I /2	TPO II /3	TPO III /4	Kernels /5
1963	141.7	119.9	97.9	80.0	68.0	62.0	54.0	50.0
1964	153.5	115.6	96.9	82.0	70.0	62.0	54.0	54.0
1965	181.8	123.5	118.8	82.0	70.0	64.0	56.0	54.0
1966	152.0	119.8	110.6	86.0	74.0	64.0	56.0	58.0
1967	149.1	96.0	95.4	86.0	74.0	64.0	56.0	58.0
1968	94.4	72.8	113.3	84.0	74.0	64.0	56.0	56.0
1969	100.8	83.8	98.7	84.0	74.0	64.0	56.0	56.0
1970	167.1	118.3	105.5	82.0	70.0	62.0	56.0	60.0
1971	158.3	122.2	92.5	90.0	74.0	70.0	56.0	64.0
1972	124.0	104.0	67.0	92.0	76.0	70.0	62.0	64.0
1973				100.0	86.0	78.0	62.0	64.0
Average:	142.3	107.5	99.7	86.2	73.6	65.8	56.7	58.4

/1 FFA not more than 3.5 percent.
/2 FFA not more than 9 percent.
/3 FEA more than 9 percent but not more than 18 percent.
/4 FFA more than 18 percent but not more than 32 percent.
/5 Containing less than 4 percent by weight of shell, fibre, rotten and/or extraneous matter and which are thoroughly dry and hard.

NIGERIA

OIL PALM PROJECTS

Estimated Economic and Financial Millgate Values of Palm Oil

It is assumed that palm oil will be imported from Malaysia in 1980 at US$ 495 1/ per metric ton and that CIF Nigeria Price is the same at the CIF Europe Price.

		Western State		Mid-West State		East Central State	
		Economic	Financial	Economic	Financial	Economic	Financial
CIF Apapa	in 1980 prices	US$ 495		US$ 495		US$ 495	
	in 1974 prices	US$ 300 2/		US$ 300 2/		US$ 300 2/	
		₦ 236.2 3/	₦ 197.4 4/	₦ 236.2 3/	₦ 197.4 4/	₦ 236.2 3/	₦ 194.4 4/
Add	Import duty 5/		₦ 39.5		₦ 39.5		₦ 39.5
Add	Handling, storage, etc. at port	₦ 2.4	₦ 2.4	₦ 2.4	₦ 2.4	₦ 2.4	₦ 2.4
Add	Transport Apapa - Ibadan	₦ 6.0 6/	₦ 8.0 7/	₦ 6.0 6/	₦ 8.0 7/	₦ 6.0 6/	₦ 8.0 7/
Less	Transport Mill - Ibadan	₦ 7.3 8/	₦ 9.8 9/	₦ 12.6 10/	₦ 16.8 11/	₦ 21.0 12/	₦ 28.0 13/
	Millgate Price 14/	₦ 237.3	₦ 237.5	₦ 232.0	₦ 230.5	₦ 223.6	₦ 219.3

1/ Price forecast for 1985 is US$ 757 or US$ 327 in constant 1974 prices.

2/ Deflating with international index 1974 = 100; 1980 = 165.0.

3/ Applying a shadow exchange rate of ₦ 1.00 = 1.27.

4/ Exchange rate ₦ 1.00 = $ 1.52.

5/ Based on the differential between the existing rate and the estimated exchange rate, i.e. ₦ 1.52 and ₦ 1.27 is 20%.

6/ 100 miles at 6 kobo per ton mile (8 kobo excluding taxes at 25 percent).

7/ 100 miles at 8 kobo per ton mile.

8/ 140 miles at 5.25 kobo per ton mile. (7 kobo excluding taxes at 25 percent).

9/ 140 miles at 7 kobo per ton mile.

10/ 240 miles at 5.25 kobo per ton mile (7 kobo excluding taxes at 25 percent).

11/ 240 miles at 7 kobo per ton mile.

12/ 400 miles at 5.25 kobo per ton mile (7 kobo excluding taxes at 25 percent).

13/ 400 miles at 7 kobo per ton mile.

14/ It was announced that in April 1974 that the sales tax of 10% would be abolished.

NIGERIA

OIL PALM PROJECTS

Estimated Economic and Financial Millgate Values of Kernels

It is assumed that palm kernels will be exported and that the value will be based on a world market price of US$ 330 1/ per metric ton in 1980.

		Economic	Financial
	CIF Europe (metric tons)		
	in 1980 prices	US$ 330.0	
	in 1974 prices	US$ 200.0 2/	
Less	Freight and insurance	US$ 30.0	
	FOB Nigeria (Port Harcour, Warri)	US$ 170.0	
		₦ 133.9 3/	₦ 111.8 4/
Less	Handling at port	₦ 1.8	₦ 1.8
Less	Transport to port	₦ 3.1 5/	₦ 4.2 6/
Less	Marketing and inspection charges 7/	₦ 2.4	₦ 2.4
Less	Bags	₦ 6.2	₦ 6.2
	Millgate Price	₦ 120.4	₦ 97.2 8/

1/ Price forecast for 1985 is US$ 504 or US$ 218 in constant 1974 prices.
2/ Deflated with the International Price Index (1974 = 100; 1980 = 165.0).
3/ Applying a shadow exchange rate of ₦ 1.00 = US$ 1.27.
4/ Exchange rate ₦ 1.00 = US$ 1.52.
5/ 60 miles at 5.25 kobo per ton mile (7 kobo excluding taxes at 25 percent).
6/ 60 miles at 7 kobo per ton mile.
7/ To be carried out by NPMC.
8/ It was announced in April 74 that the sales tax of 10% would be abolished.

NIGERIA

OIL PALM PROJECTS

Production Estimates for the Projects

1. A method of estimating adult oil palm yields from a knowledge of soil class and water deficit (estimated by a standard formula) has been used by IRHO in West Africa and has been broadly successful. Applying this to the project areas yields would be:

Metric Tons per ha per Annum (per acre in brackets)

State	WESTERN		MID-WESTERN		EAST CENTRAL
Area	All areas	Mosogar	NIFOR	Nsukwa	Whole Area
Mean Water deficit (mm) /1	320	280	335	350	280
Soil Class					
IIa	11.9(4.8)	13.1(5.3)	11.5(4.7)	11.0(4.5)	13.1(5.3)
IIb	10.4(4.2)	11.8(4.8)	10.0(4.0)	9.5(3.8)	11.8(4.8)
III	3.4(3.4)	9.8(4.0)	8.0(3.2)	7.5(3.0)	9.8(4.0)

/1 Based on calculations for the period 1950-62 made in a study of climatic conditions in Southern Nigeria by J. Olivin of Institut de Recherches pour les Huiles et Oleagineux (IRHO).

2. It has been suggested that the Acid Sand Soils covering the project areas fall into classes IIa and IIb. Yield figures for NIFOR, Ajagbodudu Estate and recorded plots in East Central State have been checked against the above table and with the aid of soil analysis data available and soil observations made during the mission a judgment has been made of the soil class, or mean soil class, in each area. The judgment is tentative for the Mid-Western areas, since soil analyses for the areas concerned are still awaited. 1/

1/ Subsequent information received after appraisal, however, confirms basically the tentative conclusions reached during appraisal.

3. In general, the Benin fasc (red) soils may be expected to be Class IIa except on slopes or where they are unusually sandy. Calabar fasc (yellow) soils may be Class IIa or IIb, but they are often excessively sandy, in which case they will be comparable to Class III soils or worse.

4. NIFOR yield figures suggest that their 'plateau' soils usually reach Class IIa. Steep slope soils are between IIb and III, i.e.:

	Plateau		Slope	
	per ha	per acre	per ha	per acre
Mean Yield, metric tons	11.5	4.7	8.8	3.5

5. Ajagbodudu Estate yields from good 1958/59 replants on Calabar fasc soil of good clay content have averaged 10.5m tons per hectare. Much of Cowan is, however, on Benin fasc. East Central State soils are mostly Benin fasc but heavily degraded by over-farming. Yields of an old plot at Mbawsi suggest that modern material would give Class IIb yields - 11.8 tons/ha - if fertilized with potassium and nitrogen. In the few areas where farming in the groves has not been so continuous, Class IIa yields might be attained under estate conditions.

6. Western State soils are mostly good Benin fasc (IIa).

Estate Adult Yield Predictions

7. "Estate standard" adult yield predictions are thus as follows (metric tons):

State	Western	Mid-Western		East Central
Areas	all	Mosogar Ajagbodudu	Nsukwa	all
Adult Yield per acre	5.1	5.1	4.6	4.9
" " per ha	12.5	12.5	11.3	12.0

Smallholders Adult Yield Predictions

8. A yield of 10 tons per ha is taken for all areas on the assumption that fertilizers are properly applied and supervision of other work adequate. For the Nsukwa area of the Mid-Western State a yield of 10 ton/ha is also taken on the assumption that all smallholders areas are to the west and south of the nucleus estate and therefore have water deficits less than that of the estate area.

Yield Progression

9. As with adult yields, yield progression is often affected by the unfavorable effects of previous severe dry seasons. A conservative view of yield build-up is therefore advisable and this is supported by NIFOR experience. Mean annual yield expectations are as follows:

Metric tons/ha/year

State	Areas	N4	N5	N6	N7	N8	N9
ESTATES							
Western	All	3.8	7.5	10.0	11.3	12.5	12.5
Mid-Western	Mosogar	3.8	7.5	10.0	11.3	12.5	12.5
	Ajagbodudu	3.8	7.5	10.0	11.3	12.5	12.5
	Nsukwa	3.8	6.3	8.8	10.0	11.3	11.3
	NIFOR /1	3.8	6.5	8.5	10.0	11.5	11.5
SMALLHOLDERS							
Western		2.5	5.0	6.3	8.8	10.0	10.0
Mid-Western	Mosogar	2.5	5.0	6.3	8.8	10.0	10.0
	Nsukwa /2	2.5	5.0	6.3	8.8	10.0	10.0
East-Central		2.5	5.0	6.3	8.8	10.0	10.0

/1 For reference only.

/2 Assuming smallholders areas are to the west or south of Nsukwa.

Oil and Kernel Extraction

10. NIFOR material which will be used is characterized by high fruit to bunch ratios, fairly high mesocarp to fruit, high kernel to fruit and low to fairly low shell to fruit (10-14%). Taking a lower figure (62.5%) for millside fruit to bunch ratios than is shown in field laboratory analysis, 90% mill efficiencies, 50% oil to mesocarp and a 6% allowance for loss of moisture from kernels, estimates of the eventual outturn are:

Percent of ffb: 22% palm oil 5% palm kernels.

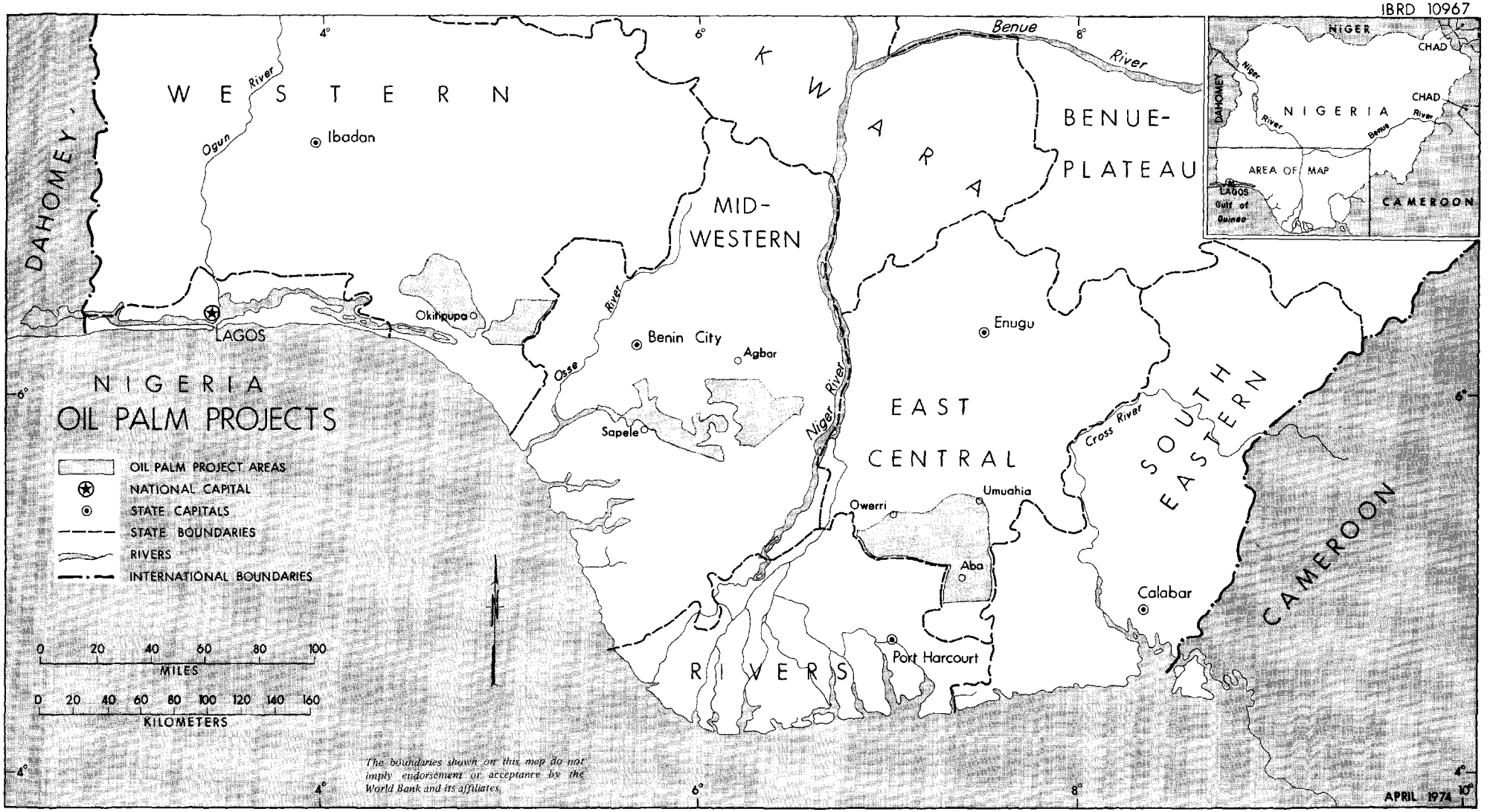
11. Figures of increase of oil to bunch with age are not available for Nigerian Tenera material. Figures provided by Chemara Research Station 1/ have therefore been used and mill extraction rates are expected to be as follows:

Percent	N4	N5	N6	N7	N8	N9
Oil to bunch (%)	16	17	18	19	20	22
Kernels to bunch (%)	4	4.5	5	5	5	5

12. Estimates of production are shown in the appraisal reports.

1/ Quoted in Bevan, Fleming and Gray. Planting Techniques for Oil Palm in Malaysia, p. 107.

IBRD 10967


NIGERIA
OIL PALM PROJECTS
OIL PALM PROJECT AREAS
NATIONAL CAPITAL
STATE CAPITALS
STATE BOUNDARIES
RIVERS
INTERNATIONAL BOUNDARIES
0 20 40 60 80 100
MILES
0 20 40 60 80 100 120 140 160
KILOMETERS
WESTERN
MID-WESTERN
BENUE-PLATEAU
EAST CENTRAL
SOUTH EASTERN
RIVERS
DAHOMEY
CAMEROON
Ibadan
LAGOS
Okitipupa
Benin City
Agbor
Sapele
Enugu
Owerri
Umuahia
Aba
Port Harcourt
Calabar
Ogun River
Osse River
Niger River
Benue River
Cross River
NIGER
CHAD
AREA OF MAP
LAGOS
Gulf of Guinea
The boundaries shown on this map do not imply endorsement or acceptance by the World Bank and its affiliates.
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