

Report on agricultural improvement of
the community lands of Goa.

by

Rao Bahadur G. K. Kelkar.

59871

From

Rao Bahadur
Genesh Keshav Kelkar,
Técnico agrícola.

To

His Excellency the
Governor General
of Portuguese India
Goa

Nova Goa, 1st September 1923

Your Excellency,

I have the honour to submit the Final Report on agricultural improvement of the Community Lands of Goa. A set of most of the leaflets, issued by the Bombay agricultural Department and referred to in the body of the Report, is herewith sent.

I have the honour to be,

Sir,

Your most obedient servant,

Kelkar
Técnico agrícola
Goa

Through,

The Director of agriculture, Forests and Veterinary,

Nova Goa

+ 14 to the Dir. of agriculture
12 to the Honorable

Kangin,

Excelentissimo Senhor Director dos
Servicos Agricolas, Florestais e Pecuarias
Nova Goa

Do Technico Agricola G. H. Kelkar

Nos termos da condicao 3/ do meu contrato, tenho a honra de submeter a apreciação de V. Ex.^a o meu relatório final, para o que nos termos da citada condicao, me deve ser abonada a quantia de Rs 2000/-

Ficou entendido, que o referido relatório fosse apresentado na lingua inglesa, visto eu não conhecer a lingua portuguesa.

Posteriormente V. Ex.^a, pessoalmente mostrou-me a conveniencia de eu mandar traduzir este meu relatório para a lingua portuguesa e imprimi-lo, a fim de ser distribuido pelas principais comunidades do territorio.

Para mais cabalmente cumprir o desejo manifestado por V. Ex.^a, bem como interpretando o seu interesse, que V. Ex.^a sempre acalenta para vulgarisação dos conhecimentos praticos de agricultura neste pais, eu entendi que no meu relatório assim vertido para portuguez e impresso devia inserir diversas gravuras, muitas das quais foram expressamente litografadas para esse fim.

A despesa que eu tive com a traducção, impressão, fotografia etc. é de Rs. 1051-04 como se pode verificar dos adjuntos recibos. É facto que esta im

importancia me seja reembolsada. Rogo por isso a V. Ex.^a a fim de se dignar tomar as providencias necessarias, para que pelo respectivo fundo me se ja paga esta importancia com possivel urgencia.

Doutrosim rogo a V. Ex.^a a fineza de mandar liquidar todas as minhas contas, bem como manda pagar todas as importancias devidas a mim, ante do fim deste mês, visto nos principios do Outubro eu ter de seguir a Penares para onde eu sou convidado leccionar o curso de agricultura na Universidade da referida cidade.

Os exemplares impressos do meu relatório tem a honra de os entregar a V. Ex.^a, assim que este jam fôrto o que com certeza não podrá ser antes da última semana do corrente mês.

Saude e Fraternidade



Exmo. Snr.

Nos termos da condição 3ª de meu contrato tenho a honra de submeter á apreciação de V. Exa. o meu relatório final, para o que nos termos da citada condição, me deve ser abonada a quantia de Rps 2000

ficou entendido, que o referido relatório fôsse apresentado na lingua inglesa, visto eu não conhecer a lingua portugueza.

Posteriormente V. Exa. pessoalmente mostrou-me a conveniência de eu mandar traduzir este meu relatório para a lingua portugueza e imprimi-lo a fim de ser distribuidô pelas principais comunidades do território.

Para mais cabalmente cumprir o desejo manifestado por V. Exa. bem como interpretando o sincero interesse, que V. Exa. sempre accenta para vulgarisação dos conhecimentos práticos de agricultura neste país, eu entendi que no meu relatório assim vertido para portuguez e impresso devia inserir diversas gravuras, muitas das quais fôrem expressamente litografadas para esse fim.

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Outrosim rogo a V. Exa. a fineza de mandar liquidar todas as minhas contas, bem como mandar pagar todas as importâncias devidas a mim, antes de fim d'este mês, visto nos principios de Outubro eu ter de seguir a Benares para onde eu sou convidado leccionar o curso de Agriculture na Universidade da referida Cidade.

Os exemplares impressos de meu relatório terei a honra de os entregar a V. Exa., assim que estejam prontos e que com certeza não poderá ser antes da última semana de corrente mês.

Saúde e Fraternidade.

Nova-Goa, / de Setembro de 1923

Exmo. Snr. Director dos Serviços Agrícolas, Florestais e Pecuários

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Saúde e Preternidade.

Novo-Goa, / de Setembro de 1923

Exmo. Snr. Director dos Serviços Agrícolas, Florestais e Pecuários



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Report on Agricultural Improvement
of the Community Lands of Goa.

Chapter I.

Introduction.

Under G. O. No. 28 dated 13th January 1920 a new appointment of an agricultural expert was created to examine, investigate and suggest improvements on the community lands of the Goa territory. This appointment was conferred on me on an agreement for 3 years. I took charge of the work on 1st October 1920.

The terms of reference on which I am called upon to carry on my work as indicated in the G. O. are as follows:-

"N. E. G. K. Kelkar, particularly to make a study of the soils of the village communities with a view to pointing out all possible improvements in machinery, implements, seeds, manures, agricultural practices, which may therein be introduced, after previous experiments which he shall make in lands which shall be placed at his disposal at his choice."

8. In order to carry out the above object my first work was to study local practices and conditions by a tour in different parts of the territory and to ascertain to what special points experiments should be directed and thus to enable myself to make my recommendations of improvements.

Tours.

8. Almost the whole of the territory was gone over for this purpose, the places visited in each taluka being as shown in the following statement, many of them were done on two or more occasions:-

 Name of Taluka : Name of Taluka : Name of Taluka : Name of Taluka
 and village : and village : and village : and village.

| <u>Ilhas</u> | <u>Moçambique</u> | <u>Sanquelim</u> | <u>Quepoa</u> |
|----------------|-------------------------|----------------------|-------------------------|
| Apacain | Chicalin | Anoná | Asolia' |
| Goa-Velha | Cortalin | Carapur | Fali |
| Merces | Dabolim | Picholim | Caçorá |
| Nevrá | Cansaulim | Lanapão | Curchoier [^] |
| Pibanter | <u>Enriaz</u> | Latantareim | Canvorém [^] |
| Santa-cruz | Aliona | Mam [^] | Mulim [^] |
| Taleirão | Assonorá | Pelipão | Paroiá |
| Juá | Colvale | Mulpão | <u>Canácona</u> |
| Cuntar-juá | Mapuca | Navelim | Nasorcea [^] |
| <u>Salcete</u> | Moirá | Nanode ^{ra} | Palolim |
| Assolna | Lavorá | <u>Fenia</u> | Lulim |
| Fenaulim | Salipão | Pandora' | <u>Satory</u> |
| Chanlor | Tivir | Borim | Caranzol |
| Javorim | Pastora' | Sansepar | Colval |
| Chinohnik | Cunchelim | Curti | Colal |
| Colvá | Canorlim | Fenchwaii | Alteier [^] |
| Cortorim | <u>Fern[^]</u> | Friol | Assolim [^] |
| Loutulim | Appervatio ^o | Querim | Fonleier [^] |
| Nacazana | Carvão | Siroia | Pissorim [^] |
| Majoria | Manirém [^] | Velinsá | <u>Sanpuz</u> |
| Navelim | Morrin | | Curpim [^] |
| Naichol | Farrim [^] | | Curti |
| Varcá | Tartoxim [^] | | Vinchundim [^] |
| Verná | Torxim [^] | | Colim [^] |
| | Sankral | | Netorim |
| | Lanparbasá | | Rivona |
| | | | Colontá |

Experiments
and
demonstrations.

4. After getting in my earlier studies an idea of the general conditions and possibilities of improvements I undertook experiments and demonstrations of such improvements as I thought to be possible from the results of experimental work done under similar conditions in British India.

(a) The experimental work was carried out as follows:-

- (1) Manorial experiments on rice in the cultivators' fields at Marpao, Carterin, Chanior and Vasco da Gama.
- (2) Trial of cotton, jowar, castors and groundnut at Marpao.
- (3) Manorial experiments, improved implements and methods of cultivation of rice at Benaulik and Paniora on community lands which were made available for the purpose.

(b) The demonstration work consisted of:-

- (1) Improved iron ploughs in all head quarter towns of all the talukas.
- (2) Seed drill for sowing rice.
- (3) Distribution of groundnut seed for cultivation on uplands.
- (4) Stocks for sale of implements and bone-meal were also maintained.

The results that were obtained of these experiments and demonstrations have been noted at proper places in the report and I have also submitted to the Director of Agriculture from time to time detailed reports of my tour and special reports on the workings of the farms at Benaulik and Paniora.

5. The present report is divided into two parts: the first deals with the investigations made by me in several directions; the second embodies the conclusions arrived at thereafter and my recommendations thereon.

Acknowledgments.

6. I acknowledge in the first place with thanks the ready and willing help given me by the Director of Agriculture and Forests in all the branches of my work viz study, experimentation and propagation.

I also take this opportunity to express my thanks to the several gentlemen who were of immense help to me in carrying out my work in Goa. To my friend Dr. ^{S. Manuel} ~~h~~irania I owe a deep debt of gratitude for favouring me with Portuguese translations of my reports and for his unfailing courtesy towards me in making valuable suggestions and helping me out of difficulties.

I am also indebted to the Director of the ^{Survey} (Agrimensura) Department for supplying me with the available agricultural statistical information, and to the Agricultural Chemist to the Government of Bombay for analysing several samples of soils and manures sent from this territory and to Mr. V. G. Gokhale, Deputy Director of Agriculture, Konkan Division, for the valuable suggestions and advice he gave me from time to time.

Part I.

The Investigations.

Chapter II.

The Position and General Description of the Community

Lands in Goa Agriculture.

7. The investigational, experimental and demonstrational work was aimed at eliciting information on the following points:-

- (1) The position and general description of community lands in Goa agriculture.
- (2) Different kinds of soils, the crops grown on such soils and the system of rotation followed.

- (3) The implements and appliances of husbandry, including waterlifts.
- (4) The manure supply.
- (5) The water supply.
- (6) Condition of agricultural stock.
- (7) Economic condition of agriculturists, land tenures, agricultural labour, supply of capital, indebtedness &c.

Description and
distribution
of lands of
the territory
and particu-
larly of
unoccupied
lands.

8. For administrative purposes the whole territory has been divided into talukas. Out of these Ilhas, Salcete, Bardez and Mormugão are included in the Velhas Conquistas and Fernão, Sanquelim, Satary, Querên, Saneuân, Fonia and Canacona go under the name of Novas Conquistas. The talukas included in the Velhas Conquistas are partly coastal and partly sub-mountainous.

All land brought under cultivation and capable of being brought under cultivation belongs either to the State, village communities or private individuals or institutions such as churches, parishes or mosques.

9. State Lands:-

Most of the State lands lying in Novas Conquistas is forest. They also comprise cultivated land at Coteçãõ in Canacona and Sankral and Langarbaga in Fernão taluka.

State land in Velhas Conquistas is situated only in the villages of Assolna, Velim and Ambelim and is all cultivated. Part of this land is under rice cultivation and part under fruit trees, mostly cocconut plantations. The cocconut plantations are under the direct superintendence of Government officials and the rice land is leased out to cultivators every three years by auction to the highest bidder.

10. Private Lands:-

Most of the private land was originally State land or land belonging to village communities; being brought --- directly from the State or obtained either from the State or village communities under the permanent settlement system. Some of the proprietors of the permanent settlement land

still pay the 'foros' whilst others by paying 20 instalments at one time have released the lands of these 'foros'.

The greater portion of these private lands is under cocoanut and betelnut cultivation, other trees such as rance, jack, cajunut etc. being also cultivated with them. The area under rice cultivation in these private lands is very limited.

11. As individuals holding private land die, it is divided amongst their heirs and this fragmentation of land has made the holdings so small in some talukas that very often some holding is just sufficient to give room to 5 or 6 cocoanut trees.

The majority of land-owners cultivate the cocoanut groves and other plantations under their direct supervision.

12. The rice fields belonging to private individuals, when leased out to cultivators are given under one of the following systems:-

- (1) Fixed on yearly or half yearly payment in cash to the owner by the cultivator.
- (2) Fixed on yearly or half yearly payment in kind (rice)
- (3) Fixed proportion of the total produce of rice in each harvest paid at the end of each harvest.

13. Lands of Village Communities:-

These lands were ^{formerly} owned by certain privileged persons conjointly who were probably the original founders of the villages. *This system was done away with many years back and now the lands are held under the share system.* These lands are distributed in almost all the talukas of the territory, but the bigger estates are situated in the Velhas Conquistas

14. As the survey of the whole territory of Goa is not yet completed, it is not possible to get accurate acreage under the three classes of lands mentioned above.

J. I. de Lofola records in his Book written in the year 1856, that there were in all 426 community estates; of these 145 were in the Velhas Conquistas and 281 in the

Novas Conquistas. The same author estimates that approximately one-third of the rice area falls under the community lands.

Mr. W. G. da Costa shows in his paper read at the Provincial Conference during the year 1921 that the total area under raiy in the whole territory of Goa is approximately 24289 Hectares. One third of this area is 11463 Hectares, which represents the area under raiy owned by the village communities.

15. In the talukas of Ilhas, Salsete and Bardez there are separate administrators for the management of the community lands in addition to those in charge of Concelhos; whereas in the Novas Conquistas, the extent of community lands being comparatively much smaller, their management as well as that of the Concelhos is vested in one and the same Administrator.

16. Each community has a clerk ^{called} Escrevão, whose appointment is made by Government. The Escrevão is to work under the direction of the Junta (village committee) and the Administrator. He is almost equal to a kulkarni in a British village. The Junta consists of a President and three members, one of them is called Procrador whose main duty is to attend to the judicial affairs and settle disputes regarding boundaries, encroachment etc of the -- community lands. There is another man in the community called Sacador whose business is to collect rent from the Fornikars and pay the same to the community office. The chief duty of the Junta is to keep the estate of the village community in tact.

17. Every three years the village committee (Junta) hold an auction sale of its fields and the highest bidder gets the lease of the lands for three years.

The communities pay every year to the State a certain sum known as 'foros' paying besides this to the State like

all private individuals the land tax known as 'pretil'.

The waste land belonging to the village communities is given out by auction to private individuals who desire to bring the same under cultivation, by a kind of the permanent settlement known as 'aforamentos'.

The surplus rent collected by the communities is distributed amongst the 'Joneiros', Taxshins and share-holders, after defraying all the expenses incurred for the maintenance of the communities' properties, office expenses and Government dues. The lands are held by the communities somewhat on the basis of a permanent settlement.

18. As the community lands are mixed up with the lands held by other proprietors and landlords, it is not possible to give a separate account of them, and therefore the general description given below of the whole territory of Goa holds good for the lands held by the village communities.

Chapter III.

General Description

Geographical Description

19. The Goa territory although a Portuguese settlement, still forms a part of Maharashtra. The range of the Sahyadri mountains has divided the Maharashtra into two main divisions. The western division running along the coast is called Concan, and the eastern portion is called Deccan and the territory of Goa is in continuation of the Latnasiri --- Collectorate of the Concan. The territory lies between 14°-52' and 15°-48' north latitude and 72°-45' and 74°-24' east longitude. It came into the possession of the Portuguese since the year 1510.

Goa is bounded on the east by the Sahyadri range, on the west by the Arabian sea, on the south by the North Kanara district and on the north by the Tiracol river and Sawantwari State. Its greatest length from north to south is about 61 miles and its breadth from east to west is about 45 miles. Its superficial area is about 1062 square miles

or 2260 square kilometres. The population is about five hundred thousand inhabitants. The total land revenue of Government amounts to about Rs. 7 lacs.

20. The following statement details the above information taluka by taluka.

| No. | Name of taluka | Total area in km ² | Population in 1910 | Density of population in 1910 | Population in 1931 | Remarks |
|-------|---------------------|-------------------------------|--------------------|-------------------------------|--------------------|---|
| 1 | Ilhas | 130.0 | 58810 | 388 | 59931 | |
| 2 | Salcete ani Morruão | 227.0 | 119028 | 358 | 108936 | |
| 3 | Fariez | 225.0 | 111512 | 497 | 127951 | |
| 4 | Morruão | | | | 22244 | |
| 5 | Fernês | 242.5 | 22562 | 160 | 26422 | |
| 6 | Sanquelim | 206.0 | 20719 | 127 | 20344 | |
| 7 | Satary | 440.0 | 17982 | 41 | 17151 | |
| 8 | Quepaz | 246.0 | 21652 | 82 | 20746 | (Paili { Chanira- { wadi { kahorek |
| 9 | Sanouet | 215.0 | 20299 | 26 | 19555 | (Mazaidar- { zeh { astrafra- { har |
| 10 | Fonia | 250.0 | 48227 | 191.5 | 50116 | |
| 11 | Sanácona | 249.0 | 19396 | 56 | 19379 | |
| Total | | 2260.5 | 486709 | 144 | 507766 | |

+ Segundo Congresso Provincial da India Portuguesa 1917. 10.^a Memoria by Sr. Froilan da Melo Sertorio e. Lobo. Page 129

Physical features.

21. The Goa territory rising as it does from sea level to an elevation of about 2500 to 4000 feet presents diverse conditions. The tract is especially hilly excepting the talukas of Salcete, Ilhas and Fariez, which also is traversed by a few ranges of low hills. A few miles east from the sea the land becomes wooded and uneven, rising into hills, that gradually grow higher and bolder till they merge into the Sahyadri range and are covered with green verdure of picturesque vegetation. Really it may thus be said to be a garden of the Concan coast. Near the Sahyadri the country is strikingly beautiful. Spurs from the main hills, detach-

of groups and isolated peaks with bold and varied outlines rise above the plain and give a picturesque appearance.

Agricultural Divisions.

22. The main industries of Goa are agriculture, forestry and fishery. The first being important, the majority of the people are engaged in agriculture. For agricultural purposes the country can be divided into three distinct tracts.

(1) The littoral area, which is a narrow flat strip of land about $1\frac{1}{4}$ to 4 miles broad lying along the coast covered over by rich coconut gardens interspersed with paddy fields. The soil in this region differs considerably in character, following the contours of the land. It changes from dry sandy soils to wet arenaceous swamps called Sazanas. Just behind the sazanas, sweet rice fields composed largely of wet clay, frequently water-logged are found, some of which being submerged, cannot be cultivated during the rains. In this region the soils along the banks of rivers are very fertile.

(2) The Sub-montane region.— This is a tract of land about $9\frac{1}{2}$ to 15 miles in width lying between the coastal area and the mountainous region consisting of high plateaus and valleys in flat lands and slopes having various kinds of soils. The laterite plateaus or table lands have a varying depth of soil, the rock cropping out at frequent intervals. Between the ranges of table lands the valleys are formed which contain rice fields where there is plentiful supply of water, the hill slopes are often fringed with betelnut or plantain gardens, with here and there a mango, jack, mosambique oranges, pine apples &c. The bulk of the rough plateaus and slopes are covered with low woods and rough grass. The soil is principally formed from laterite. The low-lands in this region are cultivated with paddy and the dry sloping uplands are partly under perennial crops, such as jack, mango, cashew-nut and barloos and partly under hill paddy, hill millets, chillies etc. The soil of the plains in the valleys is

generally very fertile, as it receives washes from the hills. The streams afford an abundant supply of water throughout the hot weather and the rice fields which are irrigated by the same yield two crops a year.

(E) The mountainous tract.- This lies to the east of the sub-montane tract, is about 8½ to 17 miles wide and is covered over ¾ with thick forests. In this region the forest is broken here and there by guneri cultivation, Nachinik being the staple crop. Vari, paco, hill paddy, culith, sesarum etc. are also grown to a more or less extent. In favourable situations paddy both on low and terraced fields is extensively grown. In some places like Satary, Querpen, Sangur, the soil is deep brown, on account of its receiving organic wash, in others it is brown or chocolate loam while in others it is light sandy or gravelly loam. During the rains coarse rank grass of various descriptions grows freely on the hill sides, but gyit makes very poor fodder.

Kind of
pial and
cultivated
land

33. According to the Imperial Gazetteer of India, Vol. V. the whole territory of Goa contains 679,660 acres of which about a third (234,754 acres) is under cultivation. The approximate distribution of the cultivated area is as follows:-

| | | |
|------------------------------|---|----------------|
| Paddy | - | 132,566 acres |
| Other cereals and vegetables | - | 77,076 acres |
| Cocconut | - | 58,124 acres |
| Betelnut | - | 566 acres |
| Other fruit trees etc. | - | 1352 acres |
| | | <hr/> |
| | | 234,754 acres. |

34. As the detailed survey is not yet complete, more accurate information is not available.

In the coastal area most of the land is cultivated.

large portion of the sub-montane region also has been brought under the plough, but a fairly large area remains uncultivated for want of labour and other difficulties. In the mountainous tract the proportion of cultivated land is very small, the bulk of which is Cumeri cultivation which is a destructive process so far as forest conservation is concerned.

Climate

25. The most important circumstance which has contributed towards the value of Goa is climate. The rainfall is mostly assured and well defined. The climate is humid and warm and therefore fits best for all tropical plants.

Rainfall

26. The whole of the rain in Goa is received from the south-west monsoon, although at times the anti-monsoon showers accompanied with thunder and lightning from the north-east are not uncommon during April and May as well as during November and December. The regular monsoon begins early in June and closes about the end of September or even a little later. Though the rain is well distributed over the whole of the rainy season, the fall is generally greatest during June and July. The rainfall is heavier in the inland than on the coast. It rises gradually from the south towards the north and from the west towards the east. From the actual rainfall of the last three years viz 1920, 1921, and 1922, it seems to vary in the territory from 62 inches to 100 inches. The highest fall is at Collem[^]. It falls in violent showers, doing a good deal of damage by washing away the soil from the cultivated fields and silting up the stream beds. Greater portion of the storm water rises up in the form of subterranean springs which are particularly common in Fonia[^], Sanguem[^], Quepem[^], Sanquelim, and Satary, all these being hilly talukas. The storm water reservoirs are a common feature in the sandy region but are few in the inland areas. The following table represents the rain fall for the years 1920, 1921 and 1922:-

| Name of place | 1920 | | | 1921 | | | 1922 | | |
|---------------|----------------------|--------|--------|----------------------|--------|--------|----------------------|--------|--------|
| | Number of rainy days | Meters | Inches | Number of rainy days | Meters | Inches | Number of rainy days | Meters | Inches |
| Nova Coa | 112 | 1685.9 | 66 | 116 | 2648.7 | 104 | 127 | 2781.4 | 109 |
| Fernes | 117 | 1578.2 | 62 | 124 | 2940.2 | 116 | 120 | 2119.2 | 122 |
| Mapuca | 107 | 1612.9 | 64 | 116 | 2507.7 | 98 | 119 | 2805.1 | 112 |
| Valei | 119 | 2829.7 | 111 | 129 | 2829.2 | 127 | 124 | 4171.7 | 163 |
| Richolim | 114 | 2262.2 | 88 | 112 | 2737.3 | 107 | 125 | 2645.4 | 142 |
| Fonia | 108 | 2842.7 | 88 | 112 | 2790.0 | 109 | 116 | 2298.6 | 129 |
| Coler | 120 | 4427.1 | 177 | 125 | 4829.2 | 190 | 128 | 4728.0 | 186 |
| Marvão | 115 | 1918.1 | 75 | 114 | 2686.2 | 105 | 119 | 2777.0 | 109 |
| Sansever | 102 | 2485.2 | 145 | 122 | 2422.6 | 127 | 122 | 2602.0 | 142 |
| Queren | 127 | 2742.2 | 107 | 128 | 4407.5 | 172 | 112 | 2600.7 | 137 |
| Valei | 116 | 1732.5 | 68 | 92 | 2622.0 | 101 | 127 | 2542.0 | 99 |
| Canacona | 119 | 2126.7 | 82 | 114 | 2601.5 | 102 | 125 | 2664.2 | 104 |
| Normuão | 121 | 1868.2 | 73 | 126 | 2206.1 | 86 | 121 | 2609.2 | 91 |

Temperature

27. Heat is rather oppressive in the months of April and May but for the most part of the year the coastal tract enjoys an equable climate, free from the extremes of heat and cold. The mean and absolute minimum and maximum temperatures month by month of the year 1922 are shown in the following table in Centigrade degrees.

| Name of month | Mean | Absolute minimum | Absolute maximum |
|---------------|------|------------------|------------------|
| 1922 | | | |
| January | 25.9 | 22.0 | 32.8 |
| February | 26.5 | 24.2 | 33.0 |
| March | 27.2 | 24.0 | 33.0 |
| April | 28.9 | 26.2 | 34.8 |
| May | 29.7 | 27.2 | 36.0 |
| June | 26.9 | 26.6 | 35.7 |
| July | 25.7 | 24.2 | 32.2 |
| August | 26.0 | 25.5 | 32.5 |
| September | 26.2 | 24.7 | 32.9 |
| October | 27.2 | 25.2 | 33.2 |
| November | 26.5 | 25.2 | 32.6 |
| December | 24.5 | 22.4 | 32.4 |

Trade Market.
Facilities for
communication
articles of
export and
import

28. Markets. - The following are the principal market places where weekly or bi-weekly bazars are held and large quantities of agricultural produce, fish, vegetables, -- fruits, and cattle change hands.

Sanquelin. - Areca-nuts, coconuts, plantains, limes, kavalunas, Mozambique oranges, jack fruits, mangoes, raisins, canears, cucumbers, birans, tamarind, betel leaves, cajus, tur, machini, culith, ori, and fuel wood &c are brought to this market for sale according to their seasons.

Picholin. - All articles like Sanquelin and pottery are marketed here. Cattle from above the phats are brought for sale, mostly by butchers.

Maruca. - A large cattle bazar is held ^{here} every Friday. articles similar to Sanquelin change hands.

Panastarig. - Here a short time bazar is held every week on Friday morning where fresh fruits of various kinds, vegetables and fuel wood are brought from Ponia, Sanquelin, and Satary talukas for sale. Fish in large quantities is bartered here.

Marrão. - Here the bazar is held twice a week. Thursday and Sunday. A fair number of cattle come here for sale on Sundays. Pottery market is important. Besides fresh vegetables and fruits are brought here. Fish market is held twice a day both morning and evening.

Panain. - Here there is a daily bazar.

29. Facilities for Communication. - It is known that good and cheap transport facilities multiply the value of produce. Along the sea coast and large tidal estuaries communication is easy, and markets are thereby readily available for the produce.

The Morrão harbour is one of the finest bays in the world. It is a natural harbour and provides a safe anchorage. It has all the advantages and facilities needed for the accommodation of ships. Weekly coasting and cargo steamers touch this harbour and bring in and carry away

large stocks of goods. There are good ware-houses close to the wharves.

20. The N.I.P. railway is about 84 miles in length. it traverses through Mormugão, Salcete, Quepem, and Sangli talukas of the Portuguese territory. It runs from the Mormugão Harbour to Castle Rock and is connected at the latter place with the N.S.M. Railway line of British India and thereby affords an easy outlet for the transport of goods from the S.M. Country to the Mormugão Harbour. Practically the whole of the trade from the S.M. Country to Porbay and Kathiawar passes through this railway.

21. Among the various enterprises undertaken in Goa by the Government agency are the launch communication by the river and the motor services through the Improvement Trust at the Mormugão Harbour.

22. In the Nova Conquistas the facilities for communication are however few. There are few good roads, others being rough forest roads and foot paths. Better communication and of transport facilities will help considerably the development of these areas.

23. Exports and Imports.- (The principal products of the territory are rice, coconuts, areca-nuts, cashew, mangoes, fish and some vegetables. Rice, sugar, tobacco, wine and cloth ^{from} ~~from~~ the chief imports. During the year 1931-32 the quantity and value of goods imported and exported are given below:-

| Exports | | Quantity | Value in Rupees | Imports | | Quantity | Value in Rupees |
|---------|-----------------|---------------|-----------------|--------------|--------------|----------|-----------------|
| 1922 | Coconuts | 34927000 No | 1703895 | Rice clean | 21357019 lbs | 3736170 | |
| | | | | " Paddy | 5512685 " | 370429 | |
| | Copra | 532169 dials | 209886 | Sugar | 931788 " | 550370 | |
| | | | | gagay | 1127771 " | 303295 | |
| | Coconut oil | 91 lbs | 42 | Tobacco | — | 735086 | |
| | cocoanut cake | 1637 dials | 160 | | | | |
| | Areca nut | 993442 " | 260898 | Cloth-cotton | 307779 " | 1629394 | |
| | Salt | 13224809 " | 324235 | " woolen | 3306 " | 106702 | |
| | Fish | — | 215788 | Wines | 204767 lbs | 208960 | |
| | Firewood | 30711 Truss | 419511 | Glassware | 34870 dials | 46525 | |
| 1920 | Tajua | 1386851 dials | 2443473 | Hardware | 2135611 " | 955404 | |
| | Mangoes | 10088180 No | 2940709 | Coffee | 63897 " | 24238 | |
| | Pine-apples | 279989 No | 15799 | Coconut | 4497 lbs | 2337 | |
| | Sweet Potatoes | 426004 dials | 37974 | " cake | 463345 dials | 44248 | |
| | Onions | — | — | Chillies | 289705 " | 89761 | |
| | Chillies | 14472 " | 4058 | | | | |
| | Vegetables | — | 19598 | | | | |
| | Mangoes | — | — | | | | |
| | Cowls (Foultry) | — | 17727 | | | | |

24. Having given an idea about the general condition contributing to the Goa agriculture as a whole, and the position and management of the community lands, I now proceed to review the existing situation of technical matters relative to rice, the main crop of the community lands under various heads as noted below with a view to help proper understanding of suggestions and recommendations of improvements to be made in a later chapter.

25. Study notes on Machini and sugarcane crops are given in Appendix No. 1. Suggestions for the improvement of these two crops as well as onions, chillies, betelnut, and cocconut are given in Chapter III which contains also notes on the introduction of new crops such as groundnut, castor, cotton, taricao, guinea grass, lucerne, jowar &c.

26. Present Situation.

Agricultural

1. Cultivating seasons.
2. Soils
3. Water supply, water-lifts and drainage
4. Tillage and tillage implements.
5. Manure supply.
6. Live stock.
7. Crops with their relative importance.
8. Rice
9. Economic condition of the agriculturists.

Chapter IV.

Cultivating Seasons.

27. There being only one monsoon, the largest area under crops stands only in the period from June to October. The land for raily is first ploughed or hand-dug (except barotas) just after harvesting the rain crop and the rest of the preparation is made in March and April and very often at least in the littoral region even sowing is done at the end of April or early in May. In many places there

is sufficient moisture (shai) in the soil to help germination, while in others tank water is laid over the land before sowing and this partly starts germination. This crop is harvested in September, so that it receives the full benefit of the southwest monsoon. Immediately after harvest, the land is ploughed and put ready, well prepared for cultivating the vamsana crop during November and December. Of course, this is practised only in such places where there are water facilities. Besides this, there are some lands which are under 2 to 6 feet of water from June till the end of September. These lands after the cessation of the monsoon are put into order and sown with paddy, which is harvested in March. Thereafter the land remains fallow till the end of the monsoon. On the whole, the usual season for the cultivation of almost all the crops including paddy and vegetables is the beginning of June.

Chapter V.

Soils.

28. The predominant rock from which soils are derived in Goa is laterite although granite, gneiss, trap, clay stone, seem to protrude frequently. Alluvial deposits of recent origin are found all along the coastal belt and also along the banks of the rivers and creeks. In these alluvial flats granite intrusions are quite common. Suddenly a small granite rock appears above ground in the middle of vast plain of sand. When the railway cuttings are looked at, the laterite is usually seen with horizontal cracks occasionally expanding into small cavities and giving an appearance of irregular stratification to the formation. In Sansalem, Querem and Janacona the laterite series is full of intrusions with quartzites, shales, gneiss and granite. Both low and high level laterites are plentifully found in Fariaz, Fernes, Sanquelin and Fonia. The scenery of barren, solid, hard, treeless plateaus are markedly observed while travelling from Pettir to Mapuca, Fonia to Ferial, Fernes to

Morpin and in various places where laterite rock prevails.

39. The soils noticed may be classified into two broad divisions, sandy and clayey. The sandy plains close to the sea shore, loamy soils found on the banks of rivers and also some lands found in narrow valleys are of alluvial origin. Sandy soils along the sea coast are ordinarily poor, but with regular seasons and steady rainfall they yield fairly good crops. The sandy plains and the wide bands intersecting the rice areas grow chiefly coconut palms. Vast sandy plains are called Queros.

The clay soils are found in low-lying situations and in valleys. They are red or yellowish red in colour, and have some times a slight admixture of gravel, which increases in quantity as the subsoil is reached. The particles are cohesive and clods harden on drying.

In some places like Muler, Cavarin, Chanier, the subsoil is very stiff and hard like a pan. In such soils the drainage is poor.

40. The various kinds of soils may further be divided agriculturally into three classes (1) rice proper, (2) plantations and (3) Bharoi or varkas.

(1) Rice lands are known by different names according to the situation, consistency and composition as described below.

(a) Local name Levat or called Pulanvat in British India. It is made of pure sand and occurs nearest to the sea coast. Without manure it yields but poorly. This soil under sufficient rainfall when treated with fish manure, is capable of growing an early variety of rice.

(b) Cazanas or Jontor:- They are deep and clayey soils found along the tidal creeks, which are reclaimed for cultivation by putting strong earthen embankments. They contain a good deal of clay and are exceedingly sticky when wet and take very hard when dry. The Cazana soil is generally more or less charged with salt. Cazanas are very productive, as they are unusually rich in plant food.

A considerable area of salt lands has been reclaimed along the Vanivi and Zuari rivers. These soils grow only one crop of paddy which is of a coarse kind. As time goes on, such lands get sweetened and become fit for growing better varieties of paddy. In places where there are water facilities, a second crop of vanguard is raised in sweetened lands. The Gazana lands of Shiroda, Marcal, Junlain, Neura' etc are well known.

A narrow strip of salt land situated on the bank of a river, which is often subjected to the influence of tides is called gagal or latti. In such soils hiris rice is grown on low lands and coconuts on the embankments and on mounds of clay made for the purpose.

(c) Shet Janin, Galal, Vanguard. - Soils of this type are low-lying and are found at the bottom of the valleys. They are clayey, deep, fertile, retentive and superior in richness. The colour of the soil varies from yellowish to dark brown. Two crops of rice are taken from this kind of soil, where water facilities exist.

(1) There are some soils in this class, where on account of their situation, water stands high in the fields during the rainy season. The rainfed rice is generally harmed by water logging. Very often this crop fails but such fields yield a second crop of rice with little irrigation.

(2) In some places like Kotorlik (Sangur) there are very low-lying, water-logged lands, which are dark brown in colour. They may be old tank beds, in which plants lived and died for decades. They cannot be entered during the rains, but in the month of November the soils are hard due (sometimes by standing on planks) and a vanguard crop is grown without any labour or irrigation almost every year. They are humous soils.

(3) Some low-lying fields retain moisture (ghal) for a long time after the harvesting of the rain fed rice. Two crops are taken off such soils. Rice is followed by leguminous crops, such as gholi, orid, cultin, aus, etc.

(4) Hollow.— In some places, on slightly higher situations there are loamy soils which receive washings from the hills. They contain a fair proportion of clay and sand.

(e) Allis.— These lands are arranged into a series of terraces each one or two feet higher than the one immediately below it. The front of each terrace is guarded by a bund about a foot high forming a part of the descending step. These soils are stony with a fair proportion of clay. They are not very retentive and sometimes suffer from drought. They grow early varieties of rice. In some places rice is transplanted on such soils. Such lands are termed Shatlas in Fernam and Mercias in other parts of Goa. There is no marked difference between Mercias and Allis, // One merges into the other. Where such lands are situated within an easy reach from the salt water rivers, the cultivators try to keep up the fertility of the soil by the addition of river mud almost every alternate year.

(f) Fatal, Khari, or Galay - (Gally or Gallio).— This kind of soil is found in the hollows or depressions on the tops of flat laterite hills. They are formed of detritus washed from the surrounding high level tract. These lands are met with largely in the Fernam taluka. They are -- stoneless, clayey and retentive and grow a good variety of rice. In this class of soil the whole of the land is burnt with leppings and cow-dung before sowing rice or nachini.

41. (B) Plantation lands.— There are two descriptions of plantation lands - one is coastal and the other hilly or ignari. The coastal plantations are in the sandy soils of the sea coast, and on the banks of tidal creeks and rivers. Here the coconut trees flourish well. The trees are watered unto the third or fourth year. Afterwards the natural moisture in the soil and the humid atmosphere above keep

and

the trees growing. In Revona, Colant, Curding Aeterlin, which are included in the ^{or at} ~~astagar~~, the cocconut trees are regularly irrigated from perennial streams. These cocconuts bear well.

Hill garden lands are numerous in the Novas Conquistas. They are usually found near the heads of valleys or on the lower slopes of the hills where water is abundant. These, with soils of gravelly or loamy nature, are fringed with betelnut plantations, with cocconut trees here and there.

43. (3) Esaroi or Varas.- They are high-lying lands. They are stony, gravelly and lighter in colour. There are two sorts of Esaroi lands - one is Lilly or lonari and the other mal. The Lilly lands are situated on the steeper slopes and are mostly cultivated by hand. They are cropped with Nachini, or ani with a mixture of tur and culith.

The mal-varas lands are fairly level parts found on the tops of hills. They are stony with very little clay. Water cannot be impounded on such lands. These are cultivated with nachini, raco, sesamum, sawa, culith, niser seed and san (crocolaria juncia) sometimes.

Kali (Meric)
soils.

43. These soils contain large quantities of various salts, mostly common salt and some others which are injurious to vegetation. The crystals of salt which appear on the surface are caused by the evaporation of water from the soil, leaving behind on the surface the salt that was dissolved in it. This problem is not very important in Goa. However, some alkaline spots in an otherwise fertile field are found.

Analysis of
soils.

44. Several samples of soils and subsoils from different parts of the Goa territory were sent to the Agricultural Chemist, Poona, for their mechanical and chemical analyses, the results of which are given below:-

| | Benaulim: | | Gado village | | Pissurlem | | Nodal | | Azona | | Mastora | | |
|----------------------|-------------|-------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|---------|
| | form | Curchorem | (Sangdam) | (Pernas) | (Satary) | (Satary) | (Satary) | (Sanquelim) | (Sanquelim) | (Sanquelim) | (Bardor) | (Bardor) | |
| | (Rice land) | (Rice land) | (Rice land) | (Rice land) | (Rice land) | (Rice land) | (Rice land) | (Rice land) | (Rice land) | (Rice land) | (Rice land) | (Rice land) | |
| | Soil | Soil | Subsoil | Soil | Subsoil | Soil | Subsoil | Soil | Subsoil | Soil | Subsoil | Soil | Subsoil |
| | % | % | % | % | % | % | % | % | % | % | % | % | % |
| Stones | 8.40 | - | - | 21.7 | 2.6 | 36.00 | 16.60 | 13.00 | 7.60 | 9.73 | 10.77 | - | - |
| Finest and fine silt | 5.50 | 6.25 | 11.93 | 3.55 | 2.17 | 16.63 | 18.30 | 15.49 | 11.64 | 43.14 | 40.64 | 8.45 | 5.70 |
| Medium Silt | 3.09 | 2.64 | 4.95 | 3.21 | 0.87 | 6.46 | 14.93 | 10.13 | 11.77 | 15.83 | 14.14 | 5.11 | 14.48 |
| Coarse silt | 7.39 | 13.09 | 17.18 | 2.98 | 1.04 | 30.24 | 19.55 | 19.46 | 12.77 | 17.51 | 19.56 | 10.59 | 7.15 |
| Fine silt/sand | 67.38 | 75.94 | 60.50 | 70.71 | 70.37 | 27.94 | 37.33 | 48.42 | 56.59 | 14.64 | 15.50 | 69.20 | 62.48 |
| Coarse sand | 15.66 | 2.04 | 5.44 | 20.55 | 25.55 | 17.73 | 9.94 | 6.50 | 7.23 | 8.82 | 9.96 | 6.35 | 7.19 |

Chemical Composition of the Rice Soils

| | | | | | | | | | | | | | |
|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---|
| Moisture | 2.24 | 0.30 | 0.60 | 0.61 | 0.45 | 3.46 | 2.51 | 2.00 | 3.38 | 3.10 | 3.10 | 0.93 | - |
| Loss on ignition | 0.32 | 0.12 | 1.92 | 2.05 | 1.82 | 7.04 | 6.86 | 8.40 | 7.89 | 6.07 | 5.19 | 4.20 | - |
| Sand | 93.18 | 93.20 | 89.64 | 75.77 | 90.56 | 37.77 | 46.34 | 53.40 | 58.24 | 63.31 | 63.28 | 89.64 | - |
| Lime (Ca) | 0.10 | 0.22 | 0.22 | 0.33 | 0.17 | 0.22 | 0.25 | 0.27 | 0.26 | 0.35 | 0.30 | 0.16 | - |
| Nitrogen | 0.03 | 0.04 | 0.03 | 0.04 | 0.02 | 0.10 | 0.10 | 0.11 | 0.10 | 0.09 | 0.08 | 0.04 | - |
| Phosphoric acid | 0.02 | 0.04 | 0.02 | 0.04 | 0.13 | 0.34 | 0.14 | 0.37 | 0.16 | 0.11 | 0.14 | 0.15 | - |
| Potash | 0.03 | 0.07 | 0.18 | 0.05 | 0.06 | 0.52 | 0.47 | 0.18 | 0.31 | 0.37 | 0.58 | - | - |

N. B. - It will be seen from the above table that the soils of Pissurlem, Nodal and Azona vary from moderately rich to normal in nitrogen; while those of Benaulim, Curchorem and Gado are very poor in this element, as regards phosphoric acid they are good and rich in Pissurlem and Nodal; Azona is good but Benaulim, Curchorem and Gado soils are poor in phosphoric acid. In case of Potash Pissurlem and Nodal are normal; Azona is rich and soils of Benaulim, Curchorem and Gado are very poor. Benaulim soil is poor in lime but in other cases it is moderately rich to normal in this element. The presence of organic matter in Satary and Azona (KhaJan) is worth noting.

Mechanical Composition of Boroda (Varikas) soils (Nachini Lands).

| | Manode (Lanquelin) | | Codal (Satary) | | Chopda (Perusa) | |
|----------------------|--------------------|-----------|----------------|-----------|-----------------|-----------|
| | Soil % | Subsoil % | Soil % | Subsoil % | Soil % | Subsoil % |
| Stones | 23.17 | 23.00 | 14.60 | 9.80 | 43.4 | 46.7 |
| Finest and fine silt | 27.69 | 24.87 | 11.46 | 12.65 | 14.23 | 13.93 |
| Medium silt | 6.14 | 6.54 | 8.37 | 10.00 | 9.89 | 9.55 |
| Coarse silt | 14.34 | 13.66 | 14.26 | 14.80 | 20.73 | 13.27 |
| Fine sand | 40.17 | 43.99 | 65.07 | 62.65 | 45.33 | 50.48 |
| Coarse sand | 11.76 | 9.05 | 10.84 | 9.90 | 9.77 | 7.77 |

Chemical Composition of Soils (Nachini lands)

| | | | | | | |
|------------------|-------|-------|-------|-------|-------|-------|
| Moisture | 2.02 | 2.46 | 3.50 | 4.06 | 1.00 | 0.53 |
| Loss on Ignition | 0.46 | 7.89 | 7.83 | 9.80 | 4.14 | 2.96 |
| Sand | 41.90 | 42.49 | 46.90 | 43.94 | 46.28 | 34.70 |
| Lime (CaO) | 0.30 | 0.39 | 0.14 | 0.21 | 0.30 | 0.09 |
| Nitrogen | 0.08 | 0.02 | 0.09 | 0.09 | 0.05 | 0.03 |
| Phosphoric acid | 0.12 | 0.10 | 0.27 | 0.24 | 0.01 | 0.02 |
| Potash | 0.12 | 0.33 | 0.48 | 0.52 | 0.04 | 0.02 |

N. B. - The figures in the above statement show that the soils are moderately rich in Nitrogen; but in phosphoric acid Manode soil is normal. Codal rich and Chopda very poor; while the Manode soil is moderately rich in potash, Codal rich and Chopda very poor. The presence of lime is normal or average.

Chemical Composition of Coconut soil.

| | Managlo | Salcete | Sangam | Dr. Viranda's |
|------------------|---|--|--------------------------------------|---------------------------------|
| | Causau- lin sea side soil | Causau- lin soil from valado river side | Velin soil from valado : | Kheri near Revana soil |
| | Dr. Viranda's outlet Quepen soil | Dr. Viranda's outlet Quepen subsoil | | |
| | % | % | % | % |
| Moisture | 0.12 | 0.52 | 0.18 | 3.24 |
| Loss on Ignition | 0.68 | 1.40 | 1.32 | 0.22 |
| Sand | 96.14 | 95.31 | 95.23 | 92.92 |
| Lime (CaO) | 1.01 | 0.17 | 0.23 | 0.30 |
| Nitrogen | 0.03 | 0.04 | 0.02 | 0.09 |
| Phosphoric acid | 0.11 | 0.02 | 0.04 | 0.05 |
| Potash | 0.08 | 0.06 | 0.12 | 0.03 |

N. B. - The figures noted above show that the coconut soils are poor to moderately rich in Nitrogen; while all are poor in phosphoric acid except Causau. Potash is normal at Velin and Kherin. The soils of Quepen, Fennulin are very poor in this element while others are moderately rich. So far lime is concerned Causau, Velin soil is rich, Fennulin, Velin and Sangam have a normal supply, while Quepen is poor in this element.

Chapter VI.
Water Supply.

45. The sources of irrigation are canals, tanks, temporary reservoirs, perennial streams, springs and wells.

Paroia canal is the only fair weather canal in Goa. Every year the canal is opened about the end of October or beginning of November and closed at the commencement of the rains. The canal water commences at Quasem and passes over a length of about 15 kilometres through the villages of Paroia, rulem, Cavorin and Chandor.

46. The vast sandy plains in the coastal region has several tanks and reservoirs, which have been very ingeniously constructed in olden times. In some places an arrangement has been provided for taking water from one tank to the other when the water supply in the last tank decreases in quantity. Recently one large tank has been constructed by the Calapur community. These tanks have been made by throwing a luni across a line of drains, so as to intercept the surface drainage, which otherwise would pass into the streams. These tanks are mostly shallow. They are rarely rain fed and are dependent on the run-off from the permanently constructed drains, which carry water from the villages and temporary streams and open out into tanks. Very frequently the tanks are the property of the communities and seldom of individuals.

47. In the Novas Conquistas, there are many perennial streams and hill-side springs. The most popular method of utilizing this water for irrigation purposes is by putting a temporary dam across the streams in several places and thus diverting the water through open channels. Besides springs and streams there are also several tanks at Cunhain, Falcair and Shiroia, as well as in some villages of Salcete which are filled with springs and jungle streams.

At the foot of the Sahyadri hills the water supply is abundant. The water for irrigation is diverted by putting up temporary dams and it is carried to the fields through narrow channels dug up in laterite rock.

48. Deep wells are hardly in use for irrigation purposes, as Goa enjoys especially heavy rainfall all over the territory. It is only at Lollo (Canacona) where the small betelnut and cocconut gardens are irrigated by drawing water from wells by Lat. This system is also observed in some villages of Pariez, Ilhas, Fernex and Fonia.

Water Lifts.

49. When the land to be irrigated stands a few feet higher than the water level in the tank, canal, river, streams or shallow wells, some kind of lift is needed to lift water.

For small farms there are principally three kinds of water lifts in use. The following will supply useful information regarding their capacities, price and labour requirements.

(1) Deni.- It is a boat-shaped counterpoise water-lift, one end of which is fixed into the water channel, where it is to be emptied. It is used in tank irrigation where the depth of water varies from three to four feet. It is worked by manual power. Generally two men work in relays and the quantity of water raised per hour varies from 1200 to 1500 gallons. This lift is met with in Canacona and costs from Rs. 3 to 5.

(2) Lat.- It is commonly found all over the territory. It is a hand-lever and bucket-lift used in raising water from shallow wells and tanks where the depth of water varies from 5 to 10 feet. To the other end of the lever is tied a stone to act as a counterpoise. Two men work in relays and raise 600 to 1000 gallons of water per hour. The quantity of water drawn varies according to the size of bucket and depth of water. It is useful when the area to be irrigated is small. The Moira, Aliona, Cumberjua and Jua are staffed with such lifts.

(3) Horli or Gallo.- This is commonly found all over where the lift is 2½ to 3 feet. It is a triangular bamboo basket swung by ropes. It is used in shallow water tank irrigation. Four men or women work in relays and lift 1000 to 2000 gallons of water per hour. The basket costs 6 to 8 annas.

Tarlan.- There are two types of this hand-irrigator, one is light, handy, small, boat-shaped scoop, about 2½ feet long and made of Lansara (Erythrina indica) wood. It is used for splashing water from a small pond to crops like chillies, brinjals, plantains etc. where the water does not flow through ordinary channel.

A larger type of this, which is long and deeply carved and shaped more like an elbow is found in the Sanquelin, ^{dm} Lays and Satary talukas. It is used in arecanut gardens for splashing water. It holds more water and throws the same to a greater distance, when it is given a jerk by the knee-joint by lifting the right leg of the operator. It is made of kaju wood and costs about Rs. 1

Persian Wheel (Nora).- This wheel, which is commonly met with in the Latnasiri district, is found in rare cases in the Ferner taluka. This wheel is worked on wells or tanks when the depth of water varies from 5 to 30 feet. It is worked by human as well as by bullock power by gear arrangement. It costs from Rs. 25 to 100 according to the material used in its construction.

Drainage.

50. In Goa the heavy rainfall in conjunction with natural drainage channels like nallas, small streams, rivers and creeks keeps the soil almost free from alkalinity.

The lands requiring drainage are low-lying rice fields, water-logged lands and ranches, Cazanas, lands where water is ^{dr} carried in excess on comparatively flat lands where water collects from the surrounding country.

In places good drainage arrangement of low lands has been made. For example, in the low-land rice area near the

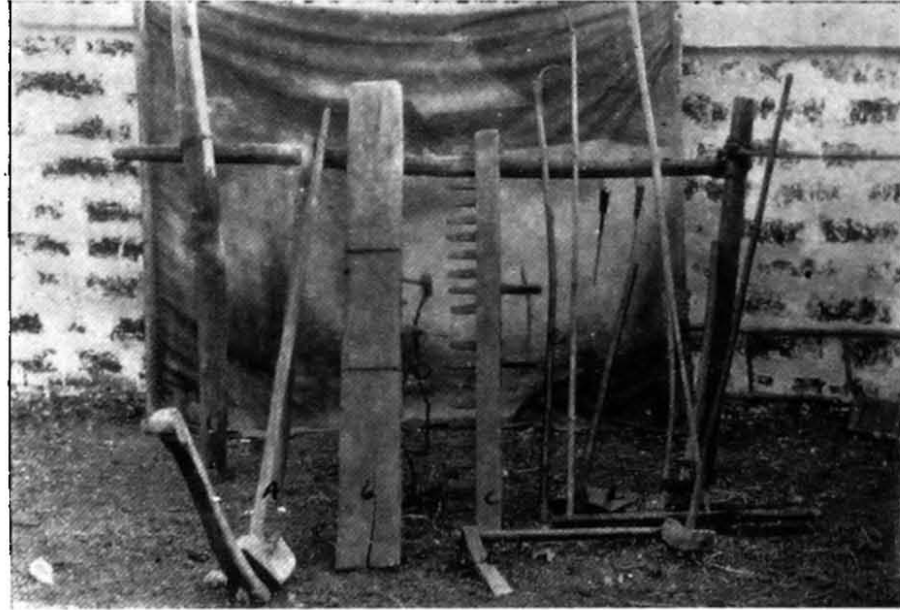


Illustration No 1.

Indigenous Implements - (a) Plough (b) Hoe (c) Dibble
 (d) Furrow (e) Water-lifting (f) Frame (g) Nivolum
 (h) Dibble

"Balodyan Press, Poona."

head quarters of the Zanáoona taluka, the drainage of excess rainwater is very satisfactory. Trenches are dug up at intervals over the land, which carry the surface flow and open out in the low-lying river. In the coastal region owing to the flat nature of the country open ditches are set with for draining the coconut areas. But these ditches are not maintained well by removal of silt and grassing their sides to prevent them from falling over.

51. In the coastal region, sudden storms, succession of days and over-irrigation of the low-lying areas cropped in rice, give rise to salt lands in small patches. Such places are met with in the community lands at Benaulia, Na, Assassine etc.

Chapter VII

Tillage and Tillage Implements.

52. The several implements used in Goa are cheap, light and to a certain extent effective. They are made and repaired by the village carpenters. They are made of wood which is available in the forest.

53. The implements can be divided into two groups - the first group includes those that are worked by bullock power such as the plough (nagar), the leveller (Cloi), the heavy leveller (Gunte), and the tooth cultivator (Danto); the second group consists of hand-tools such as the hoe (Forem or Corer), the cutale, the sickaxe, the cloi crusher (Divolo) the land leveller (Nivelex), the crow-bar (Faroi), the sickle (Vilo), the coyte, the coytul, the axe (Curafi), the val, the rhavfi and the hook (Kaicul). (Vide illustration No. 1)

Plough.

54. The plough commonly used in Goa is very small in size as found along the konkan coast, or perhaps in most rice growing countries of the world. In the different parts of the Goa territory it does not vary very much in weight,

size, make or form. All the parts are made of wood except-
ing the share, which is made of iron. In some places the
stilt or handle is quite separate from the body and shoe,
which are in one piece. In others the body, the shoe and
stilt are all made out of one piece (vide Fig. 8⁽²⁶⁾ of illus-
tration No. ²⁶₄ 26)

The weight of the plough varies from 13 to 21 lbs. and
costs from Rs. 1 to Rs. 1-8-0.

The plough is drawn by directly tying the beam to the
yoke by a loop of rope. A pair of small bullocks, cows or
she-buffaloes or he-buffaloes is used in Goa to draw the
implements. When the plough works, it opens a V shaped
furrow 2" to 4" deep and 4" wide at the top and about an
inch at the bottom, leaving a narrow ridge of unploughed
land between two consecutive furrows. The furrow slice is
not turned over, but the clods of earth are thrown on both
the sides of the furrow. While ploughing the whole field
is divided into sections and each section is finished by
working the plough round and round. When there are two or
three ploughs at work, they work and follow one behind the
other. When the land is to be broken, stirred and pulve-
rized thoroughly, the plough has to be worked several times.
The land is ploughed and cross ploughed to make one com-
plete ploughing. In this way four to six ploughings are
given for the thorough preparation of land.

The wooden part of the plough lasts for about 6 months
and the share needs sharpening once in the season and re-
placing once in three years. In Maroide the ploughs wear
out sooner. It ploughs about 16 gunthas per day during
seven hours work.

The principal use of the plough is to break the land
preparatory to sowing. It is also used for sowing ^{on} early
crop of raddy according to Shole and Tagad method, either
in Shel or Malapa lands. When the plough is so used, pieces
of coconut fronds are tied on both the sides of the body
of the plough to facilitate the opening of a wider furrow

and throwing over more earth in covering the seed while making the next furrow. It is used in mixing seed with the soil when paddy and other seeds are sown broadcast. Besides it is used for ruffling the soil.

eller (Cloi) 55. It is simply a plank the ends of which are rather curved on the side which touches the ground. The length of the plank varies from 54" to 58". A split bamboo is inserted into the plank for hitching to the yoke while working. The leveller weighs from 17 to 20 lbs. and costs from 12 annas to Re 1. (Vide Figure ^(b) of Illustration No.1)

The Cloi is used after each ploughing. It breaks clods and levels the soil. It is also used for levelling the ruffled soil.

In Nova Conquistas where clay soil predominates, the Ganta takes the place of Cloi. This implement only differs from Cloi in being a little heavier.

or Lanto 56. It consists of a wooden beam or a plank, about 5 feet long, about 4" wide and 3" thick. Into this plank 10 to 20 lines made of Fherla reed (Caryota urens) or reed are inserted projecting about 6" in front of the plank. Nane (Lagerstrassia parviflora) wood plank is preferred for this implement, a split bamboo inserted in the body of the plank, the other end of which is hitched to the yoke. The implement is very often drawn by hand. It is very poor in effectiveness. The object of working this implement is to scratch and smoothen the soil. During the rains when the soil is quite ready to receive the seed of Rohu (sprouted seed), the implement is drawn over the land which leaves behind very shallow ridges or marks and when Lohu is sown broadcast, it flows with rain water and steadies against the ridges and begins to grow. After some time the appearance of the field is something like a drilled paddy in lines. There is no doubt that the lines of Lanto left in the field help in draining the land to a certain extent and

and thus ~~the~~ secures the young seedlings of rice, a bed free from oversaturation. The weight of beds varies from 13 to 15 lbs. and its price from 12 annas to Rs. 1-8-0 (Vide Figure ^(c) of Illustration No. 1)

Yoke.

57. This is made of teak. It is a slightly bent single yoke which is used for working all the implements. The space intended for the movement of the neck of the bullock when yoked is only 2". No pins are inserted in the holes of the yoke, as is found in other parts of the Bombay Presidency. But the bullock is secured to the yoke by tying pieces of strings in the holes. The yoke weighs about 8 lbs and costs from 8 to 12 annas. The total length of the yoke is 4'-4" and the length from neck to neck is 1'-11"

The above described three implements ~~form~~ form the full complement of the preparatory appliances, but in several places, they have been reduced to two - the plough and the Choi or Chalis.

Land tools

58. The Forem or Coram.- It is a hoe, which is extensively used in Goa. It varies in size and shape; but one most in use is a plate of iron about 7"-10" long and about 5" broad, sharpened at the cutting edge. To this a bamboo handle about 4' to 4½' long is fixed for working (vide figure No. ^(f) of Illustration No. 1). In the coastal tract a considerable amount of land is hand-laboured by this tool. So is the case of all Collyan lands. But the cost of accomplishing this work is very great. Forem is used for digging and turning over the soil, digging coconut beds and weeding the plantations. It is used for repairing ridges, beds, head-lands, and for distribution of water in irrigated tracts. It is used for stirring and filling baskets with earth, sand and various other materials. The Forem costs about Rs. 2-8-0.

The Chici or Chicli.- It is a one bladed pick, used for digging. It is largely used in digging and levelling

cut in Gazana lands just before sowing seeds. Its price varies from Rs. 2 to 2-0-0 (~~Vide figure No. of illustration No. 1~~)

The Rickava.- It is a strong, slightly curved bar of iron tipped with steel. About its middle a wooden handle is fixed to operate the tool. One end of the tool is usually pointed while the other end is flattened out and sharpened like an axe. It is used for digging holes, removing stones, digging coconut beds while manuring; the flat end is used for cutting side roots of coconut trees, while the pointed one is used for digging. The smaller types of rickavas are used for shaping laterite rocks. The large rickava costs Rs. 3 to 4.

The Rivula or Clod breaker.- It consists of a rather bent piece of wood 2" x 2" thick and about 10" to 11" long to which a handle about 5' long is fixed for manipulation. This hand tool is used in the fair weather after each ploughing for breaking clods and making the soil finer by pulverizing it. It smoothes the surface of the soil for distribution of seeds. The tool costs about 4 to 6 annas (Vide figure No. ^(h) of illustration No. 1)

The Hand leveller (Rivula).- This tool is used in levelling cut in Vansana cultivation just before broadcasting seed. It consists of a plank 2½' long and about 4" wide to which is fixed a long bamboo pole for manipulation. It costs about 4 annas.

The Breaker (Harai).- It is a very useful implement and used for digging holes, where the Guloi and rickava cannot be worked. It is used in cutting up shrub fences.

The Sickle (Vila).- It is a small sickle mostly saw-toothed which is used for harvesting crops as well as for weeding. It costs about a rupee.

Kovis.- It is a large knife, long, broad and heavy-bladed with a ~~short~~ short handle. By its means bushes

are cut down and small trees lopped. It is used for cutting wood and pruning large branches. It costs from Rs. 2-8-0 to 10-0-0.

Chital or Bireal.- It is a small sickle used for cutting young branches of trees and plants.

Jurali (axe).- It is used for cutting trees, wood &c. It costs from Rs. 2-8-0 to 8-0-0.

Pal.- It is a sharp, small, crooked hand tool, made of steel and fixed into a short wooden handle. It is generally used for cutting branches of trees and shrubs in Gujerat cultivation.

Davali.- It is a wooden shovel used in the threshing yard for collecting grain. It consists of a semi-circular piece of plank, into which a short handle is inserted for manipulation. It costs about 4 annas.

The hook or halkal ^{or Mursund}.- It is a small iron hook fixed to the end of a bamboo. It is used for stirring grain and chaff and for shaking rice straw in the threshing yard. It costs from 2 to 6 annas. Sometimes a bamboo branch with a hooked ^{end} takes its place.

Chapter VIII.

Manure Supply.

59. Water and manure are two of the principal wants of a farmer and they are interdependent on each other. Fortunately the Goa territory is situated in a heavy and assured rainfall tract, having abundant rainfall though confined to only four months of the year, and the real need therefore is that of manure.

60. The necessity for manuring is determined usually by the amounts of the most important constituents of plant food existing in the soil namely, nitrogen, phosphoric acid, potash, lime and humus.

Nitrogen is absolutely necessary for the healthy development of the green parts of plants. Phosphoric acid

leads to increase the flowering and fruiting tendencies to plants and also increases the yield of seeds and roots; it makes the crops ripen earlier. Potash helps the production of leaves, the deposition of starch and the formation of roots and wood. The chief function of lime is to make the other constituents of soils ^{di} really available; it also increases the flowering and fruiting tendencies. Manure supplies nitrogen, and is also necessary to maintain the texture of the soil.

If analysis of the soil shows the irregularity of any one of the requisite foods, they have to be restored by the application of manures.

Cattle dung and Urine

61. Out of the various sources of manures available and used in Goa the most important manure easily and generally available in farming is cattle dung and urine, the great fertilizing value of which can be very well seen from the experimental results of Rothamstead ^(England) quoted below:-

| Period | Corn in bushels per acre | Straw in cwt. per acre | Weight of grain per bushel | Remarks |
|--|--------------------------|------------------------|----------------------------|---------|
| | Unmanured Plot. | | lbs. | |
| 30 years 1853-1871 | 14½ | 13 | 57½ | |
| 20 years 1872-1891 | 11½ | 8½ | 66½ | |
| 1892 | 9½ | 7½ | 59½ | |
| Continuous wheat manured annually with farm yard manure 14 tons per acre | | | | |
| 20 years 1853-1871 | 35½ | 32½ | 60 | |
| 20 years 1872-1891 | 33½ | 31½ | 60½ | |
| 1892 | 33½ | 20½ | 61½ | |

The superiority of the farm yard manure is clearly marked in the manured plot.

62. The general practice of conserving farm yard manure which consists of storing only cattle dung in an open pit is faulty to a certain extent. Much of the valuable constituents are lost and more particularly nothing effective is

long to conserve the urine, although some farmers in the coastal tract particularly in Velgão, Lajoria etc. make an effort to preserve urine by spreading sand in the cattle shed which is occasionally removed and heaped separately.

The practice of making cowdung cakes and burning them as fuel is not general in Goa but is prevalent mostly amongst the Hindus. Of course a large quantity of cowdung is dried and turned into ashes before being used as manure whereby practically all organic matter and nitrogen are lost in the burning. This is a great loss, because soils are generally poor in humus.

fresh dung

63. The methods of using cattle dung as manure in Goa are many. Fresh cowdung is very largely used in manuring betelnut gardens. The cowdung is preserved in several vats distributed all over the plantation μ (culácar) and a small quantity of cowdung is baled out by a long ladle and added to the stream of water in the channel while irrigating the plants every fourth day. This is a good practice of applying liquid manure to plants.

In the rainy season when the field work is over, the cattle from Lajoria, Causaulim etc are taken for grazing to the hilly parts of Dabolim, Mormusão etc. There the coconut plantation owners have constructed several cattle sheds for herding cattle during night. 20 to 50 cattle are folded in each shed. Once a fortnight the Shátgans arrange to scrape off all dung and urine from the shed and apply them to coconut trees. This is done only during the rains. The grazers receive 8 annas to Re 1 per head of cattle in the season for folding them in the cattle sheds. This method is an excellent one where practically the full use of dung and urine is made.

cattle tying.

64. Towards Canacona, Satary and Fernex, and sparingly every where cattle are tied in fields in the fair weather in specially constructed movable wáias (made of bamboo tatis). The cattle are tied during night in the wáias, the

urine falls in situ and the fresh dung is spread in the adjoining fields. The urine is dismantled in a week or so and erected in another place. This process is repeated until the field is completely manured. In places cattle are tied to coconut trees and they are removed from tree to tree every fourth or fifth day. This method of utilizing cowdung and urine is a good one.

..

Goats' urine
of urine.

65. Some shepherds with goat herds come from the British territory and settle in the hills of Fernán from 2 to 4 years. The herds graze in the hills and also on the rice and nachini stubbles. Some cultivators take advantage of these herds by making the shepherds fold their goats in the fields for manuring. They are given a certain amount of paddy per 100 goats per night. In Satary, Sanquelin, Sanquén, Querén and Canácona there are several shepherds who permanently reside in villages at the base of the hills. They keep buffaloes, cows and goats. They graze them in the hills and stay for several months there. They cultivate nachini, paddy, orí and chillies on manures obtained from these animals. The ordinary cultivators in these parts do not seem to take advantage of folding goats in their field.

Urine.

66. Pig is a domesticated animal only in the Christian houses. Pig dung is carefully preserved and not allowed to be wasted. Even from the roads and open spaces, the dung is collected in baskets. Women are frequently seen with a basket and long ladle in their hands, searching for pig dung. Pig dung is powdered before use. It is used in the shoo method of sowing rice and also applied to garden crops like chillies, onions, sweet potatoes etc. It is used in the nursery bed for raising rice seedlings. Pig ~~urine~~ dung is more nitrogenous and when applied alone, it encourages more leafy growth than grain. Therefore instead of using it singly, it is advisable to mix the same with ashes, cowdung and other manures before use.

Human excre-
ments.

67. Night soil is not used as manure. But human urine is carefully preserved in Paries and especially in the *leira* and Aliona villages. It is held in earthen pots and utilized for manuring garden crops.

Ashes.

68. Another most important manure used in Goa is ashes. Everything possible that the people can secure is turned into ashes. Leaves from trees, dried cowdung, sweepings from houses, leaf stalks and other material obtained from coconut trees are burnt and reduced to ashes. Household ashes as well as other ashes are preserved well in ash pits, which are *ਯਯ ਯਯਯਯ* roofed over. In this pit useless parts of fish, as well as urine is thrown. Very often the ash pits are used as urinating places.

Ashes are used in manuring rice fields, inferior millets, garden crops and vegetables, coconut latins and what not. Ashes are used in mixing rice seed while sowing according to *Shoko*, *Panji* or *Tassak* method. Wood ashes are a valuable source of potash. Ashes from coconut husks contain more potash.

bat Guano.

69. It is available in old houses, church vaults as well as it is found in large quantities in caves and hollows of hills, where bats construct their nests. The supply is, however, limited. It is used in villages situated near the hills. At *Neterlia* (*Sancapuck*) it is used for manuring rice, sugarcane and other garden crops. The quantity used is very small, but it is said to be very effective.

poultry and
bat Guano.

70. The small quantity of the manure obtained from these birds is used for manuring garden crops.

Fish.

71. Fish is very largely used in the coastal tract for manuring rice, machini, coconuts and market garden crops. Fresh fish are used for manuring coconuts along the coast and the dry fish for rice and garden crops. Fresh shell fish (*gates*) are used in some places for manuring coconut trees and chillies. Fish *manure* is sparingly used in the *Novas Conquistas* as the tract is at some distance from

the sea.

The koira plantains are solely grown on fresh or dried fish. No other manure is applied. Fish manure is specially prepared before application. Fish are buried in a small pit and watered slightly. They are kept there for a couple of days and afterwards the whole heap is cut fine and mixed well with a hoe before application. The mixture is applied in small doses to plantain trees.

Fish manure supplies nitrogen as well as phosphoric acid. It supplies plant food directly and stimulates the soil indirectly. It is stated that when once the coconut plant is used to fish, it must be applied always, otherwise the tree fails to yield nuts and sometimes ~~the tree~~^{it} succumbs.

Salt.

72. This substance is comparatively cheap in Goa. It is largely used for manorial purposes. The baroia which grow an early variety of raily are manured with salt every alternate year. It is extensively used in manuring coconut trees almost every year. In some places coconut trees are watered with salt water from creeks in April. About 10 to 15 pots (each pot holds about 4 gallons) are applied to each tree once in a year. ~~Wanooes~~ ~~also~~ ~~receive~~ some measure of salt. Salt is an indirect manure and perhaps according to local cultivators' opinion salt has a tendency to disintegrate the particles of soil.

Loio (river mud)

73. Another largely used material for improve the fertility of land is Chicol or Loio from creeks and rivers. It is very much used on lands, situated not very far from the river. Sometimes it is carried even to long distances. The Loio contains clay, humus and some lime and therefore it is of great use in ameliorating the condition and the fertility of high lands which are generally poor in productivity. Loio from sweet water tanks and ponds is also used in manuring coconuts and the vegetables. It is a common scene in the fair weather to see baroi lands studded with

hears of loio and also cocconut basins dressed with the same material. Samples of creek mud (Lodo) kindly analysed by the Agricultural Chemist, Poona, during 1922 gives the following figures of analysis.

| | Line percent | Phosphoric acid percent | Nitrogen Percent |
|---|--------------|-------------------------|------------------|
| ^{a river} Creek mud ^(Pinnacreek) | 0.67 | 0.45 | 0.31 |

* The sample contains organic matter.

Oil Cakes.

74. Unif (Callorhylum inehyllum) and Wonstan (Hydrocarpus wightiana, Flure) cakes are sparingly used as manures where they are available. Wonstan trees are mostly met with in betelnut gardens. Wonstan cake contains 2.98 % of nitrogen and unif about 3 percent.

Foliage Manure

75. In hilly talukas where Sayal is plentifully found, it is extensively used for manorial purposes. It is used in two ways - one in % its original state and another after burning.

In its original state, green lopping of trees and bushes are cut into small pieces and used for manuring chillies, sugarcane, roots and tubers grown in hills and also very extensively applied to the basins of betelnuts and cocconuts.

In places green leaves and young branches of certain trees and shrubs are collected, cut up in very small pieces and strewn on the surface of the rice land, one month before vandana crop is sown. This is a kind of green manuring.

Burning of land.

76. Again in burning the soil two or three methods are followed. In Suarina cultivation, the branches of trees and shrubs are cut, spread out and arranged well all over the area and when dry they are burnt in gila. Sachini and ori seeds are sown in ashes.

In land situated at the base of the hills where sachini and rice are cultivated, the loppings are trans-

ferred and the land burnt. Just after the closing of the monsoon, the trees in the forest adjoining the rice and nachini lands are lopped, when they are fairly dry, are tied into bundles and taken to the fields where they are allowed to remain till the months of April or May when the heaps are spread out and set on fire and when so burnt the rice or nachini seed is sown in ashes and mixed by ploughing.

There is another method of burning the soil before sowing. Fir logs of dry wood are arranged in a line. They are set on fire during April or May and as the ground is burnt they are moved onwards little by little until the entire plot is burnt. In so burnt land rice seed is sown which is afterwards mixed with the soil by ploughing. This process is called Turavni. In Ferner taluka where transplanting method of growing rice is practised the seedlings are raised in a nursery where lopping of trees and shrubs from the forest, cowdung, rice husks and grass are arranged in layers and burnt in April. This process is known as Malag / in the Goa territory and Rak in British India. In the nursery bed so prepared, rice seed is sown broadcast before the commencement of the monsoon.

Soil Methods
Manuring

77. Besides the above manures so far described, heated earth, freshly dug earth from fields, red soil from uplands, shells and sand $\frac{1}{2}$ from beach and creeks and lime from shells are used for manuring coconuts. Heated earth is also used for vegetables and garden crops. Red soil is largely used in betelnut gardens for renewal of used up earth.

Chapter IX.

Live Stock.

78. The domestic animals of Goa consist of cows, bullocks, pigs, goats and poultry. The following figures show the number and distribution of animals according to the

cattle census made during the year 1917.

| Taluka | Cattle cow type | Cattle buffalo type | Horses | Asses | Sheep | Goats | Pigs | Iskarks |
|-----------|-----------------------|---------------------------|--------|-------|-------|-------|-------|---------|
| Alhas | 5900 | 1900 | 150 | - | - | 500 | 1000 | |
| Alcote | 15115 | 4880 | 131 | 21 | 20 | 1000 | 10386 | |
| Ardez | 11411 | 2474 | 87 | 10 | 10 | 1208 | 16030 | |
| Bernam | 6077 | 2472 | 21 | - | - | 2813 | 1843 | |
| Banpuem | 7013 | 2200 | 8 | - | - | 1200 | 423 | |
| Batary | 2148 | 1663 | 8 | - | - | 682 | 20 | |
| Buepen | 4227 | 827 | 12 | - | - | 600 | 2273 | |
| Banquelin | 2206 | 1204 | 27 | - | - | 869 | 408 | |
| Bonia | 5869 | 1803 | 22 | - | - | 2000 | 1664 | |
| Banadona | 4140 | 1727 | - | - | - | 300 | 262 | |
| Total | 68201 | 21220 | 467 | 31 | 30 | 12270 | 54411 | |

79. The cows and buffaloes are fairly distributed all over the territory. The pigs are chiefly bred and reared in the coastal tract. They supply meat, manure and maintain the village sanitation in a very satisfactory condition. Goats are kept by shepherds in the hills and they are maintained by some in towns and villages for their milk. A few fowls are reared by all classes of people. But some people make a speciality of breeding and rearing ducks during the fair season. The turkeys are bred by a special class of christians. The poultry on the whole are very small in comparison with European breeds.

80. In Coa as in the British India cows are as a rule kept to produce cattle for field work as against meat, milk and work production in the Western countries.

In certain places for example Sacora, Aquissin, Kulén etc. a large number of he-buffaloes are used for field work, but they cannot stand the heat of the sun, like bullocks and require plenty of water to keep them in good health.

Agricultural operations and transport of goods by roads are performed mainly by bullocks and buffaloes. In an agricultural country like Goa, the importance of cattle is very great.

81. The period of field work for cattle is practically confined to June and July and where there are facilities for vansana cultivation, there is some work for cattle during October and November. But vansana is confined to small areas. In Dalapa and Shel areas cattle have some work during April or May. But all these areas are small. -- Although there is a great rush of work at such times, the work cattle have practically no field work for about 6 to 8 months of the year. In the littoral region the cattle are generally poor. Grazing lands are limited or totally wanting. The only available fodder is rice straw. As a consequence the number of work cattle kept by the farmer is very much limited. Some of them have no cattle at all and they perform their field operations by ~~using~~ borrowing their neighbour's cattle or all the work is done by manual labour.

82. In the submontaneous and hilly tracts there is plenty of grazing though of a poor and coarse kind. The grazing is found only during the rainy season from July onwards and probably lasts for a month or two after the cessation of rains. Later on till the beginning of the next rains the cattle are let loose to roam about wherever they can pick up anything. After the harvest of rice, there is some grazing in the stubble and green grass on the -- boundaries of fields. But for about 8 months of the year, there is semi-starvation. There is no sufficient storage of fodder the rice and nachini straw is required for feeding working bullocks and milk buffaloes; and so this period proves a trying time for the rest of the cattle. The set back which they receive in the hot weather is hardly repaired.

83. Although professional breeders called Dhanwars rear large number of cows, buffaloes, young calves and goats in the high hills of Caley, Joller, Canacona etc, nevertheless almost all the agriculturists and particularly those in the hill areas are ~~the~~ rearers of cattle to a more or less extent. The Dhanwars keep fairly good cow and buffalo bulls for breeding purposes, but they do not castrate the young bulls till they are 4 or 5 years old. The bulls are castrated by the Lulline method.

84. In many cases, the agriculturists from the plains hand over their working animals, dry buffaloes, cows and young stock to the Dhanwars for rearing in the hills, when there is no work. The owners of betelnut gardens and also some cocconut plantation owners make a regular business of rearing cattle during the rains, specially for their manure. The Botes in Nova Conquistas have always spare cattle-sheds for tying these additional cattle during the rains. The Botes receive from the owners of cattle 2 to 4 annas per head per month for the care of the animals. Generally all town people send their milk animals excepting those in milk and cultivators their working animals to suitable neighbouring localities where there are good facilities for grazing. When the cows and buffaloes calve, they are returned to the owner but the other cattle are taken away home when required for work.

The average cultivator's bullock is a small stunted looking animal. It is fairly active but quite incapable of holding on for prolonged work. Specially during the vaneana season, the cattle are worked only four hours in the morning (6 to 10 a.m.)

keeping of Cattle.

85. Lulline Shala.- During the fair weather the cattle are tied outside under a temporary shed with open sides and

during the rains they are housed in a low roofed cattle shed. The roof is either of grass, coconut or betelnut leaves. Doors and sides of the shed are well closed in the hilly tracts, where there is danger from tigers during night. The floors are not properly attended to and the urine is not properly drained away; the feci-troughs being defective a good deal of fodder is wasted. In most of the places a manure pit is provided but it is left open throughout the year.

86. Cattle Feeding.— The principal sources of fodder in Goa are the grazing or cutting of green and dry grass, the straws of paddy, machini, ori, sawa and bye-products, such as cowpea, val, uril, mus and culith, green and dry grasses from heathlands of paddy fields, the weeding and the cut over-growth of paddy crop. Thus cattle are partly grazed and partly fed.

When grazing runs short and especially during the hot weather the cattle are fed on various kinds of leaves from trees and bushes, such as

Orbor (*Ficus ploverata*), Marani (*Acanthus ilicifolius*)
Phani (*Thespesia populnea*), Asan (*Bridelia retusa*)
Panpara (*Erythrina indica*), Kevan (*Helictes laera*)
Parboo (*Pearusa vulgaris*), Dhanan (*Grevia tiliaefolia*)
or Jondo

Cart bullocks are fed well. But farm bullocks and buffaloes are fed well only when they are actually employed on field work. The cow or she-buffalo receives her share when she is in milk. At times of hard work each bullock gets a pound or half a pound of oil-cake or a pal ($\frac{1}{4}$ payali) of ground and steeped culith every evening. In some places paddy is cooked and about a pal is given to each working animal. In places oil-cake/ is fed dry and at others it is steeped in water before-hand.

Milk animals.

87. Cows give very little milk, while she-buffaloes produce fairly good quantity of milk which is nearly twice as rich in fat as cow's milk. In towns milk buffaloes are kept by Cavalia, private people and also by some cultivators. Several Cavali families from the Karnatak have come to Goa and established themselves since a long time at Marpão and Karuga. They bring buffaloes from the up-country and also purchase them locally and daily sell their milk. They live in the ~~the~~ suburbs of towns, where there is light grazing. The milk is brought into towns both morning and evening to supply the customers.

88. Some of the Christians in towns purchase cows from amongst the cattle that are brought for sale by the Mahomedan dealers. They are fed and maintained until they produce milk. No sooner do they run dry than they are sold to butchers. On the whole the milk supply in Goa is very inadequate. In villages it is very hard to get any milk although several milk buffaloes are to be found therein. Some people keep goats for milk.

89. Both cows and buffaloes when dry are used for field work. Christians have no religious objection to use these for draught purposes. They are worked both at plough and for drawing carts. At Marpão, it is a common sight to see straggling thin, poor looking cows drawing building stone carts. The drivers always walk with the carts. Hindus too have no objection for using she-buffaloes for field work.

90. The concentrated foods given to milk animals are rice bran, Sharda (husk and bits of kernels of pulses), cotton seed, safflower cake, coconut cake and sesamum cake.

Chapter X.

Crops.

91. On account of heavy rainfall and other peculiar climatic conditions rice has been the principal crop grown

in Goa from time immemorial. The present systems of cultivation of rice are described in detail in a separate Chapter.

92. Next to rice the most important food crop is nachini. This crop grows well in properly drained situations and therefore it is a crop of uplands. In these uplands, in addition to nachini, vari, paco, sava, culith, sesakum are cultivated to a more or less extent. Udi, culith, mup and tur are grown as mixed crops with nachini. In fairly level situations, hill rice (ignara bhata) is also grown.

93. In fields where moisture is retained for some months after the harvest of the early crop of rice, a second crop of culith, chavali, udi, mup and such other pulses is grown. Tur is either cultivated on alluvial banks of rivers, as on the banks of Tiracol river or as a row crop with nachini and vari in Cunerin.

94. In the coastal tract water is found at a small depth and thus small individual patches of chillies, onions, sweet potatoes, water melons, tendolin and other vegetables such as wali, bhendi, radish, brinjals, chitki-mitki and cucurbits are not uncommon in the rice areas during the cold season. This sort of garden cultivation is extensively met with at Assaok, Jua, Cuntarjua, Noira, Alioná etc.

In the Novas Conquistas where water facilities are at hand, sugarcane is cultivated in small plots. During the rains chillies are grown in uplands. Hill cultivation of chillies in Canacona is well known. Chillies are also grown in small patches during the cold season where water facilities from the streams, ~~and~~ rivers and rivulets exist. They are usually ^{watered} obtained by hand.

Several kinds of roots and tubers such as kalia, canas, caranias, yams, Kai-canas etc are raised by Dhanpans (sherheris) and other hill tribes on the uplands.

In the hilly tracts these crops are grown by every household on a small scale.

95. Cocoanuts (*cocos nucifera*) and betelnuts (*areca catechu*) are the next important money crops. Coconut fringes the sea coast, banks of rivers and creeks. They are also cultivated inland on marai lands. Extensive inland plantations are found in Fonda, Sanguem, Quepem and Canacona. In the coastal coconut gardens, fruit trees such as mango (*mangifera indica*), Jack (*artocarpus integrifolius*) and unil (*calophyllum inophyllum*) are commonly met with.

96. In the betelnut gardens, the following trees are found, Mango, Jack, bread-fruit trees (*Artocarpus*) and Ehiron - Indian mangooseen (*carcinia purpurca*), lime (*citrus acida*), mahalunga (*citrus medica*), pomelo (Toranja) (*citrus decumana*) Mosambique orange (Laranja), Plantain (*Musa sapientum*), pine apple (*ananas sativa*), ram-bal (~~antara~~) (*anona reticulata*), custard apple (*anona squamosa*).

Plantains and bananas are cultivated all over Goa, but systematic cultivation is met with only at Moira and Allona.

97. Barbooa and cashewnut plantations on hill flats and slopes of laterite hills are extending every year. Cashewnut is becoming a very profitable crop in places where in fact nothing else would grow successfully. A kind of liquor is extracted from its fruit, which is very much appreciated in Goa. The inside bean of the cashewnut is very largely used in India and is also exported in large quantities to foreign countries where it is used in confectionery.

98. The following statistical table gives the details of the area under rice, Feroia, Canavial, Palmur etc. in the talukas of Ilhas, Ponda and Sanguelim for which survey has been completed, together with the proportionate area occupied by village communities.

| | Ilha | | | | | | | | | | | |
|-----------|----------|--------|---------|---------|----------|----------|--------|----------|---------|--------|-----------|-----------|
| Ilhas | 57239079 | 689684 | 114,142 | - | 4905122 | 169,3821 | 0,7078 | 18723178 | 198890 | 0,7576 | 3171,7144 | 796,2615 |
| Ponds | 16959041 | 23286 | 918345 | 29,4871 | 10711307 | 35676902 | 22601 | 16910010 | 0763495 | 183842 | 2197,6610 | 424,2764 |
| Sanquelim | 18025818 | 188416 | 275288 | 1120417 | 650,4847 | 59077103 | 43716 | 10934479 | 2272721 | 677523 | 4276,1362 | 1172,1275 |

Out of the above total areas the following figures refer to community lands only.

| | | | | | | | | | | | | |
|-----------|----------|-------|--------|--------|---------|----------------|-------|-------|--------|---|---------|----------|
| Ilhas | 33730227 | 46336 | 45999 | - | 3782773 | 467368 | - | 76123 | - | - | 6016338 | 119,3896 |
| Ponds | 3712740 | - | - | 117652 | 3927656 | 11018274 | 16643 | 35985 | 0,4522 | - | 2003868 | 72,2107 |
| Sanquelim | 3214051 | - | 0,0225 | 470715 | 786293 | 20251275-13696 | 62239 | 22843 | - | - | 8186240 | 182,6004 |
| | | | | | | | | | | | 1826605 | |

| Ilhas Taluka | Arrozal | | Vangam | Dias Novidades | Boroda | Canavial | Palmer | Arecal | Palmer K Arecal | Cajual | Boroda "Cajual" | |
|-----------------|----------|---|---------|-------------------|----------|----------|--------|----------|-----------------------|---------|--------------------|-----------|
| | Borodio | Borodio Com Culturas Horticulas Arvorie frutife- ras | | | | | | | | | | |
| Ilhas | 57239079 | 689684 | 114,142 | - | 4903122 | 189,3821 | 0,7078 | 18723178 | 198890 | 0,7576 | 317,7144 | 794,2418 |
| Ponda | 18959041 | 23286 | 918545 | 29,4871 | 10711307 | 35676902 | 2,661 | 16920010 | 8753495 | 18,3542 | 2197,6650 | 424,2764 |
| Sanquelim | 10025818 | 188418 | 275288 | 1120417 | 658,4847 | 59077103 | 43715 | 10934479 | 2272721 | 677323 | 4276,1362 | 1172,1275 |

Out of the above total areas the following figures refer to community lands only.

| | | | | | | | | | | | | |
|-----------|----------|-------|--------|--------|---------|----------|-------|-------|--------|---|---------|----------|
| Ilhas | 57730227 | 46336 | 45999 | - | 3782773 | 467368 | - | 76123 | - | - | 6016336 | 119,3896 |
| Ponda | 3712740 | - | - | 117652 | 3927656 | 11018274 | 16643 | 35985 | 0,4522 | - | 1102296 | 72,8207 |
| Sanquelim | 5214051 | - | 0,0025 | 470715 | 786293 | 70251275 | 13696 | 62239 | 22843 | - | 923267 | 182,6008 |
| | | | | | | | | | | | 8186240 | |
| | | | | | | | | | | | 1825008 | |

99. Thus although several kinds of crops are found grown on the community lands, still they occupy quite an insignificant position in comparison with rice which may be said to be the only important crop. It is therefore the crop of rice alone which has formed the subject of investigation and improvement in this report. Out of the rest brief accounts of the present state of cultivation of machini and sugarcane are given in Appendix No. I.

Chapter XI.

Rice. *Davay*

100. Rice forms the staple crop of Goa, the climatic conditions obtained being most suitable for the same. It occupies 48 % of the total area in Ilhas, 11 % in Ponda, and 10.8 % in Sanquelin.

Soils.

Rice is grown on various kinds of soils ranging from sandy to clayey with all intermediate grades and also on uplands of varying textures. A detailed description of the conditions of soils and situation which rice occupies has been already dealt with under soils.

Rice fields are divided into small compartments or beds according to the contours of the land. The object of making these small divisions and also keeping the soil in it perfectly level is to facilitate the holding and keeping up of an even layer of water within the area. Levelling of rice beds is a very important item in rice cultivation.

Seed usage.

101. No special effort is made to separately collect seed for sowing. Some careful cultivators do it, but ~~generally~~ generally seed for the next year's rain crop is reserved from the lot on the threshing yard. When threshing operations are in progress, the weather is monsoonish, the crop cannot be well dried, and it gets perhaps partly heated in

the hear and thus it is very difficult to secure good seed at this season. Of course, the well-cleaned good seed of the lot is selected, dried and then preserved in hulaa of rice straw or in earthenware pot bins.

102 In the majority of cases rice seed used in vanaana cultivation is obtained from the freshly harvested kharif crop. In certain places Panchwali seed is preferred while in others it is obtained from up-country places like Supa, Khanapur, Lonla etc.

103. Before storing, the seed is mixed with Mirca leaves (*Vitex negundo*) and Cashu nuts as preservatives against insect attacks; and every care is taken to preserve it from leanness. But it seems, many of the seeds must have lost their germinating power by the heating process in the temporary stack and this may be one of the reasons why the cultivators stick to thick ^{seedling} ~~sowing~~.

Methods of
Sowing.

104. Different methods are adopted to suit different conditions. All the different methods can be grouped into two kinds:-

- (a) Transplantation of the seedlings, and
- (b) Sowing of seed once for all in the field.

Transplantation is followed only to a very small extent in the low-lying situations while sowing of seed once for all in the field is the method followed most commonly. The methods of cultivation again differ in different conditions of soil and season, of which at least six classes might be distinguished.

105 (a) Transplantation.- In the transplantation method the seedlings are required to be raised first in the seed-bed. These seedbeds are of three kinds:-

- (1) Jalan seed-bed, which is called in British India as rat seed-bed.
- (2) Shel seed-bed.
- (3) Loku seed-bed.

(1) The selection of land for seed-bed is invariably made in well drained situation. In the case of Jalar method small turps of cow-dung are first strewn in a nursery, a second layer of loppings of shrubs and plants is given, which is covered with a layer of grass. The whole mass is set on fire during April or early in May. Rice seed is sown broadcast in the ashes and mixed with earth by means of a plough and the land levelled with a plank harrow. The seed-beds are either sown in May or about the advent of the monsoon or just after the burst of the monsoon. The seedlings are ready for transplanting in about a month or six weeks. A good seed-bed of one Guntha (1/40 of an acre) supplies enough seedlings to transplant an area of 8 to 10 gunthas, but ordinary seed-bed supplies seedlings to plant five to seven times the area. The Jalar system is in vogue in localities which are favourably situated for the supply of materials required for burning seed-beds. Burning makes the soil porous and friable and the eggs of insects and weed seeds are killed and the ashes serve as manure.

In some places the seed-beds are not burnt as in Sanquelir and Satary. Here cattle are tied on the seed-beds in the fair weather. The land is ploughed, the clods broken and the soil is made fine. The seeds are sown in the bed on the advent of the monsoon.

(2) Shel seed-bed.— This method of raising seedlings is met with all over Goa. It consists of sowing seed-beds about a month before the starting of the monsoon either on natural moisture of retentive fields or on artificial irrigation. The Shel land is ploughed twice or three times and levelled by working the plough. Before second ploughing a manure mixture consisting of cow-dung, pig-dung, fish and ashes is applied. The rice seed is sown broadcast and mixed with the soil by ploughing and the land is then levelled. Some farmers sow the seed-bed by choko method. The Shel system is a very advantageous method because the seedlings are ready for transplanting early in June, while the seed-

beds sown by the beginning of the monsoon do not get ready until July.

(5) Loku Asai-lai.-- The method of sowing sprouted seed in the nursery bed with quick acting manure like fish or pig-fung is found here and there in very rare instances. This system is practised only to make up the deficiency of seedlings. In this case the seedlings are ready for transplantation comparatively in a shorter period.

As soon as the soil is softened by the first monsoon showers, breaches of the bunds are carefully repaired prior to cultivation and at the same time the height of bunds improved. The land is ploughed lengthwise called lag and the second ploughing is done which is called alag. Manure, if any, is applied before ploughing. Water is impounded to kill stubble and weeds and the land is left alone for some time. When the seedlings are ready for transplanting, the field again receives good tillage by four or five ploughings with the working of a plank (leveller) at intervals. All the bunds are again repaired to facilitate the impounding of water. The tillage about this time loosens the soil to a depth of about a foot by breaking even the smallest clods, making it uniform in texture and completely riddled.

When the land is thus ready, the seedlings grown in the seed-beds are up-rooted, roots washed in water, tops of the seedlings nipped off if overgrown, and they are tied into bundles. The bundles are taken to the area to be transplanted and spread over the riddled field. The planter who is about a knee deep in mud and water, takes the bundle in his hand, opens it, takes 4 to 8 seedlings and plants them in a bunch 9" to 1' apart each way. When the field is well manured, the cultivators plant only four or five seedlings. Generally there are very few weeds in this system of planting rice. However one weeding is required to be given in about a month or so after transplant-

ing. No further attention is required to be given to this crop excepting keeping on the land a proper depth of water.

106. (b) Sowing of Seed once for all in the field.- Rice seed is sown either dry or after sprouting. Generally dry seed is used in sowing lands before the rains and sprouted seed after setting in of the monsoon. The dry seed sowing is practised in the following:-

- (1) In Stole method.
- (2) In Lassa method.
- (3) In sowing khari or Galax lands.

Sprouted seed is sown in several kinds of soils.

- (1) In seed-beds.
- (2) In kharol, sandy, low-lying and alluvial soils.
- (3) In the Vansana cultivation.
- (4) In Gazana cultivation.

Preparation of
land for
the next year's
crop.

107. The preparation of the land for the next year's crop usually starts immediately after the harvest of the kharif (Sorohio) crop. The land is either ploughed or hand dug. The period during which the field is in proper condition for the first ploughing is generally very short in dry soils and if the soil dries too much, it gets so hard that the plough hardly makes an impression on it, and the ploughing has to be postponed till the early rains fall. A cross ploughing is given in March or April, clods are broken by small ballots, two or more ploughings are given and the land is left level and ready to receive seeds.

In the higher lying dry lands, the field operations commence after the soil is thoroughly soaked with rain in June.

* Method of sprouting seed.- The sprouting of seed is either done by putting seed in a basket or in a halo made of rice straw. The basket or halo with rice seed is dipped in cold water during night. The next morning the basket is taken out, covered with grass or leaves, and weighted down with stones. On the third day the basket is watered twice or thrice at intervals. On the morning of the 4th day the sprouted seed is ready for sowing.

Shel land and the lands from which vanpana crop is taken, are similarly prepared by giving four or five ploughings, the clois when dry are crushed with rallets, the stubble and weeds are collected and burnt and the soil levelled by working the plank harrow. In case there is no sufficient (Shel) moisture for germination of seed, wherever possible, it is artificially brought about by laying tank water over the land. Repairing and cleaning embankments and all other operations are completed by the end of April or the beginning of May.

In the coastal tract, shel lands (both natural and artificial), dry soils and in tank beds, the system of sowing rice prevails, which is called Shoko or Punj method. It consists in making furrows by a light plough and then dropping a mixture of dry rice seed and ashes in the furrow in groups not exceeding 5 to 9 seeds in each place. Some people prefer to sow the mixture in continuous lines instead of in groups, this system being named as Tassan. Whether Tassan or Shoko, the sowing is done at the end of April or commencement of May in anticipation of rain.

In the case of Shoko method, when the plants grow up, the crop gives the appearance of a transplantation system. This system as well as Tassan system facilitates hand-weeding. *The most troublesome weeds are Ner, Karolem and Mugel*

When there is no shel and the seed is sown in dry land the process is called Dulapp.

In certain localities only one ploughing is given to the field and after working the levelling board dry seed is thrown broadcast in the month of May and the mixing of seed with the soil is done by one more ploughing. The land is levelled. This is a wasteful method.

in the coastal tract.

108. Most of the maroif lands are manured with salt in the month of May at the rate of about 800 to 1000 lbs per acre. Such soils when situated near the creeks or rivers,

receive river mud every alternate year, which is brought in head or cart loads and heaped on the land in the fair weather. On the commencement of the monsoon the mud is partially spread in the field or is allowed to spread itself by rains and two ploughings are given. In the hilly tracts where mud is not available, cowdung from the manure pits is brought and spread in the fields before ploughing. The bunds are repaired and unploughed portions in the corners are ~~ploughed~~ hand dug and then two more ploughings are given. The Changa, heavy leveller is then worked, which is followed by Lanta (tooth harrow). The sprouted seed (Rohu) is sown broadcast and the ashes are thrown over all the field. In some places ashes are mixed with seed before sowing. Lands situated in the vicinity of hills are largely benefited by deposits of silt, which is in fact the only manure which the rice lands receive during the rains. Most of the baroti lands depend solely on rainfall and therefore great attention should be paid to the bunds to facilitate the irrounding of the full quantity of water. In the low-lying lands, alluvial soils on river banks and in all places, where sowing of sprouted seed is practised, the methods of preparation, levelling, sowing, hand-weeding and reaping are all the same. On account of the working of the Lanta (ਯੋਧਾ) (tooth harrow) as the last operation before sowing, the plants after some growth give to the field the appearance of a drilled paddy.

In Satary, que-an, Sanadona and some other parts of hilly tracts the baroti land receives different treatments. Such lands are covered with dry leavings of trees from the forests in the months of February and March. They are set on fire during April or May. When the land is thoroughly soaked with water during June, sprouted seed is sown broadcast and mixed with the soil by one or two ploughings and the Changa is drawn over the land for levelling. No further

attention is given to the crop except one hand-seedling. At this time seedlings from thickly grown places are uprooted and planted in blank places in the field.

Cultivation of Khari or Galav lands.

109. In the case of Khari, the whole area is treated with Jalay during March. The ashes are mixed with the soil by giving two ploughings - one lengthwise and the other crosswise. The clods are crushed and the soil levelled with a plank harrow. Dry seed is sown broadcast during May and mixed with the soil by giving a turn of plough. These lands become inaccessible during the rains and therefore all the operations take place in advance of the monsoon.

Cultivation and Sowing of Monere Phate

110. The hill paddy (Monere Phate) is largely met with in the talukas of Pernar, Sanquelin and Satary. This paddy is sown only on stony and well-drained hill-sides. No bunds and no impounding of water is necessary in this case. The land is ploughed twice and Shula is worked to level the land. The Monere-seed is soaked in water over-night and thrown broadcast on the land the next day. The ashes are spread and mixing is done by means of a plough and the land is levelled. No further attention is given to this crop.

Cultivation of Cazana lands.

111. There are three kinds of Cazana lands - Saral (Phat or Phatty), Canter and Cazana. All the Cazana lands are provided with automatic gates in the embankment for increase and excess of salt or sweet water.

In the case of Saral (the land next the river) the gates in the embankment are open throughout the year and the salt water enters and goes out freely. The land is hand-till in May and as soon as the water in the river becomes sweet the uprooted seed is broadcasted. The growing of paddy in such lands is very risky. If the rainfall be inadequate, the land gets salty and the crop suffers and if the rain falls in continuous and heavy showers the land gets submerged and the crop is damaged.

In the case of Cantor, the crevices in the embankment are closed about the end of February. When the land is dry, it is hani due in April or May. When the water in the river becomes sweet, it is admitted on the land, clois are broken by Quiol and the land is sown with sprouted seed.

In the case of Cazana gates are provided to keep out water. These gates open towards the river. Inside the Cazana area channels are provided for salt water to flow out. Salt water is not allowed to enter upon the rice land but occasionally once in 5 or 10 years, the whole of the Cazana land is covered with salt water from the river for about a couple of months during the fair weather and then it is allowed to go out. This is specially done to manure the land with salt and also to reduce the number of snails (Conpas), who do an enormous amount of damage to the young crops of paddy. After admission of water the outturn of paddy for the first two years is said to be reduced by about half, which is made up by the rearing of a large crop of fish during these years. Perhaps fish rays more than the paddy.

The cultivation of Cazana lands consists in tilling the land during the months of January, February and March and then leaving it in large clois. The rest of the operations are undertaken after setting in of the monsoon. When the land is thoroughly soaked with water, the mud is levelled by drawing Quiol over it, and the sprouted seed is thrown in the mud. If there are blanks in the field, they are filled up by pulling out seedlings from thick patches and transplanting them in vacant spaces. *The Dhondo and Kuddi weeds are pulled out at the same time.* No other attention is necessary, excepting watching and repairing breaches, if any, in the embankment.

Cultivation of Varsana.

118. Varsana rice is cultivated only on such soils as have facilities for irrigation either from a reservoir, a tank, or from a dammed-up stream.

As soon as the monsoon crop is reaped, the land is flooded with water until it is thoroughly softened. The land is either hand-tue (as in the coastal sandy region) or ploughed. The land is ploughed and reploughed four to six times until the field is well tilled. A flat board is drawn over the surface after each ploughing in order to level it and the field is then ready for sowing. In the sub-montane region the flat board is not worked as often on clay soil but only once in the majority of cases, the day before the seed is sown. In the meantime the bunds are scraped of all grass and repaired and made fit for impounding water. The cattle manure collected during the rains, ashes, fish etc. are spread, and the artificially fermented seed (Rohu) is sown broadcast on the surface of the mud. On the next day all the water is drained from the field. The first and second waterings consist simply in running water over the plot, which are applied at an interval of 2 or 3 days.

By this time the plants begin to shoot up and the crop is irrigated every third or fourth day, in such a way that the water will stand in the field throughout the growing period. The watering is stopped about a fortnight before harvesting. The crop is usually weeded once or twice.

The Vansana is sown in December in the coastal tract and in the months of December-January in the sub-mountainous region. Generally the crop arrives at maturity from about the middle of March to the end of April, varying according to the position of the field and the time of sowing.

Harvesting and
threshing.

113. The crop sown in May and June is harvested in September, but Gazana rice takes a little longer time and is reaped in November. The Vansana crop is sown in December and January and is harvested in March and April.

Rice is harvested when the lower grain in the ear is still a little green, because if the crop is reaped at this stage, the shelling of seed in the field could be prevented. During the month of September when generally the early rice is harvested, there is very often danger of getting some showers of rain unexpectedly. Therefore the rice crop immediately after harvesting is tied into bundles and taken in heat-loads to the threshing yard where it is temporarily stacked. In the case of a vangsana crop, it is sometimes allowed to lie in the field for a couple of days for drying. In the case of Cazana, the crop is put together into small temporary stacks on the field and afterwards threshed according to the convenience of the farmer. In certain places like Macazona, Fanchwall etc. the cazana crop is immediately threshed after harvesting during November, because fresh seed is required for sowing of Vangsana crop. Most of the rice grown in the sandy soil tract and in the Cazana lands is threshed out by trawling by men.

The threshing yard is carefully prepared. A hard ground is selected. It is first dug 5 to 6 inches deep. Big pieces of stone and other rubbish are picked out and removed. The land is then watered and pulled nicely. The excess moisture is allowed to drain away. Cattle are then made to trawle on the surface to further consolidate the soil. When it is fairly hard, it is plastered over with a paste of cowdung, and then it is ready for the commencement of threshing operations.

Threshing is generally done under the feet of bullocks. This is common throughout the territory. For this purpose rice straw is spread thickly round a stout pole fixed in the middle of the threshing yard. Six to eight bullocks or buffaloes are tied abreast and loosely secured to the central pole and then driven round and round on the spread-out mass. During the process of threshing, the mass is

frequently moved by a hand-rake called ladhul. When the operation is nearly complete, the straw is raked off and after removing the grains from below, the straw is again threshed a second time in the same way, and afterwards if any grain that may still be left unthreshed, it is beaten out with sticks.

The rice is then winnowed, by shaking out gently out of a basket or w-Sapp, by holding it against the wind, when it is blowing briskly. The labourer while shaking stands on an elevated platform specially made for the purpose or on the ground according to the pp briskness of the wind. Further cleaning of grain is either done by loop or by bamboo sieves. When there is no sufficient breeze, then it is artificially produced by holding a double fold of the laniri (mattine) between the legs or by holding a woven cocconut leaf against the breast and shaking them briskly. But this could be done only for a short time.

Preparation of Rice.

114. In the preparation of rice, the paddy is first milled in the primitive mills which are either of stone or of wood. Subsequently fine bran etc are separated by rounline, and winnowing, and cleaning are done by sieves and Sour.

Generally the proportion of cleaned rice obtained from paddy is about 2/3rd by weight and about 2/3 by measurement.

According to Jose Maria de Sa, Asso and Corbett yield 18 cudes of cleaned rice per Sanni, Shirtoo 10 cudes and other varieties about 10 cudes.

In the mortar and pestle method of preparing rice, many grains are broken. Selling price of the entire grains is also high.

Uses.

115. In Coa rice is eaten in two forms. Mida (Far-boiled) and Sirni. In the case of the former the paddy is first soaked in water and then boiled in earthen pots. It is taken out on cocoline and dried in the sun for two or three

days before pounding and separating the grains from the husk. The Burai rice does not require any previous treatment before pounding.

Varieties.

116. There are many varieties of rice which differ in shape, size, weight, colour, consistency and quality. Some are specially preferred for Eat (Sanji), some are considered fragrant, some are most digestible, while others are more nutritious, and so on. The finer varieties are not generally grown in Goa. Those that are cultivated are either coarse or medium. Most of them have red coloured grain and very few have white coloured grain.

The growing period of most of the varieties in Goa varies from 85 to 100 days. Bonchoro, Dargo, Sabry, Aspo, Kharo-aspo, Kussalpo, Shiridy, Belo, Merkar, take 105 to 115 days, while the Shirto requires 120 to 135 days.

Early varieties are the crops grown in a dry, sandy loam, stony and gravelly soils where water supply fails early. The late ripening varieties occur on low-lying, clayey and Bazana soils. Early varieties produce coarser grains and the late ones also produce comparatively coarser seeds. The majority of the people prefer coloured coarser grain.

High class people prefer Aspo rice in Ilhas, Fatni and Quensial in Salcete, Dargo in Paredes and Shirto in the Novas Conquistas. Shirto swells well on cooking and therefore it is economical. Barablia (labourer class) invariably prefer Corant rice. It is said to be more substantial and takes time to digest. Quensial rice is considered good for making Cariss, which is drunk by almost all classes of people in the Goa territory.

117. The following represents the names of varieties etc. found in Goa:-

Names of Rice varieties sown according to the kind of soil.

| Place of Taluka | Cuzmas | Sandy and loam soils | General | Moroí | Hilly | Vangama | Remarks |
|-----------------|-----------|----------------------|---------|--------------|---------------|---------------------------|--|
| lhas | Corgunto | Quendal | | | | | |
| | Shirly | | | | | | of all the varieties mentioned the following only are largely cultivated:- |
| | Shirly | | | | | | |
| | Asgó | | | | | | Cuzmas- Corgunto and Asgó |
| | Cusúlgó | | | | | | Sandy and loam soils . - Quendal, Chonchori |
| Salcete | Cirto | Quendal | | Belo | | Cirto | |
| Morungao | Asgó | Shedo | | Devi Patny | | from | General.- Damgo, Chonchori Fernar |
| | | | | Tambry Patny | | Curtoria | Moroí.- Devi or Tambry Patny |
| | | | | Chonchori | | | |
| Bardez | Corgunto | Quendal | | | Turia | | Hilly.- Dongre-lim |
| | Shirly | | | | | | Vangama.- Cirto |
| | Caró-angó | | | | | | |
| | Cirto | | | | | | |
| Pernem | Corgunto | | Damgó | Navan | Dongre- im | | |
| | Chonchoró | | Dundga | Patny | Turia | Cirto from Curtoria | |
| | Shirly | | | Avachitam | | | |
| | | | | Chonchori | | | |

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| | | | | | |
|-----------|-----------|-----------|-------------------|---------------|---|
| Sanquelin | Gorgunto | Dungo | Chonchori | Dongre- in | Sirto from |
| | Shirdy | Quendal | Patny | | |
| Ponda | Chonchori | Vali | | | |
| | Gorgunto | Bernare | Devi Patny | Dongre- in | Sirto from Supa or Panchwadi |
| | Asgo | Chonchori | Sirty | | |
| | Sanalga | Belo | Cumali- | | |
| | | Bune | -NIVAN | | |
| | | Dungo | | | |
| | | Balery | | | |
| Canacona | | Pandya | Muthalga Patny | Goliyo | Local Sirto |
| | | Chonchori | holo Pandya | | |
| Satory | | Quendal | Patny | | irto from Khanapur or Supa Sirto |
| Panguem | | Chonchori | Turbry or Devi | | |
| | | elo | Patny | | |
| Quepem | | Quendal | | | Sirto from Supa |
| | | Vali | | | |
| | | Bernare | | | |
| | | Belo | | | |
| | | Chonchori | | | |
| | | Balery | | | |

Note:- (1) In S.—West Sazana lands, Asgo, Balery, Bune, Gorgunto, Chonchori, etc are cultivated.
(2) In hard clay lands Bernare and in Sandy or clayey soils of Chonchori, predominates.

Rotation.

118. Generally rice is grown year after year on the same land because the condition under which it is cultivated compels one to do so. The water itself by constant ^{renewal} ~~renewal~~ during the rains brings with it certain quantity of silt, which helps the improvement of land to a certain extent.

In certain localities places where conditions for vanaana cultivation do not exist, but /where the soil is retentive of moisture, a second crop of rucas such as culith, cowpea, ^a mil, mus, tur, etc is usually taken. The land is ploughed twice and levelled. The seed is sown in the furrow opened by the plough or it is sown broadcast and covered over. In some places chillies, onions, melons etc. market-garden crops are raised on rice lands during the fair season. Occasionally sugarcane rotates with rice in favourable situations.

Preparation of rice.

119. Now on account of labour difficulties rice hulling and cleaning machines are gradually being set up in Goa. People boil their rice and bring them to the mills or the owners of mills perform this business by steaming and then drying the grain before hulling. During the milling process the kernels are decorticated and the gluten layer is removed. In the process of polishing a film of gluten and starch cells are not rid off.

Yield of Paddy.

120. The outturn of paddy varies very much from field to field according to the soil, situation, rainfall, climate and several other factors.

Mr. Jose Inacio de Leicia in his book on agriculture published in 1896 gives the relation of outturn to seed as follows:-

| | |
|-------------|---------|
| Cazana | 15 to 1 |
| Vanpana | 8 to 1 |
| Other lands | 6 to 1 |

Mr. Jose Maria de Sa in his book published during 1900 gives the proportion in the case of:-

| | |
|---------|---------|
| Cazana | 80 to 1 |
| Others. | 10 to 1 |

Mr. Fernandino de Costa gives the relation of seed to rice as 1 to 10 in Ilhas, Salcete and Bardez; 1 to 8 in Fonia and Pernex; 1 to 6 in Sanquelim, Queper and Canacona and 1 to 4 in SaMquer and Satary.

Chapter XII.

condição economica dos agricultores
Economic Condition of the Agriculturists.

Land

Land.

121. The community or the landlords are generally the owners. The actual worker in the field is a tenant-at-will called Bhacali and possesses no permanent interest in the land and therefore feels little to improve it. The owners are equally apathetic in the matter of making any improvements to their properties. As long as the community is the owner of the large areas, the management is done simply on general broad lines, i.e. putting the land to auction every third year, arrangement of water supply, collection of revenue etc. The millerman or Fawaniker who buys the right of cultivation of the land at the auction, arranges for the sub-letting of the land, for money dealings with the tenants and recovery of the share of the produce. Thus the Fawaniker lets the land cultivated by tenants-at-will on the share system of the produce in kind. The tenants employ their own labour and supply all other requisites for the cultivation. The rent is collected for each season separately in two instalments at the end of each cultivating season.

122. Size of individual fields.— Although the land is generally owned in large blocks by the communities or individual land-holders, the actual cultivation is carried

on in very small parcels of land aggregating from 2 to 3 acres of rice land for each cultivating family. This individual area is again not cultivated in one spot but in several fragmentations.

123. Value of Land:- Community lands cannot be sold or mortgaged. The value of the individually owned lands however varies from Rs. 6000 to Rs. 10,000 per hectare.

Recently the combination of several factors has led to a great rise in the value and rent of land. The various factors influencing the present rise are:-

(1) Return to Goa of several low class moneyed emigrants, whose greatest ambition is to build a house and buy some land near by.

(2) General tendency of the labouring and some other classes such as merchants, ~~bankers~~, bakers, barbers, shoemakers, carpenters to be land owners.

(3) Rise in the price of rice in British India and consequently rise in Goa.

(4) Settling of old enmities and feuds during the currency of the lease by auction of communal rice-fields.

All these causes do not influence ^{equally} ~~equally~~ in all villages. They are more in evidence in Velhas Conquistas, especially in densely populated villages of Bardez and Salcete. In some villages of Novas Conquistas and even in some of Velhas Conquistas, the value of the land has actually gone down for want of labourers.

124. Rent of Land.- The rent which the ultimate tenant has to pay to the Fawnikers for communities rice lands varies from 20 to 25 Muzas of paddy per hectare which represents about one-half of the gross outturn. The rent payable by the Fawnikers varies with the competition evinced at the triennial auction. These rents have gradually risen in proportion to the rise in prices. *For variations in rent of the community lands, vide Appendix No 5.*

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In the case of individually-owned lands, the rent is generally fixed in kind per plot of ^{one} ~~acre~~, which works out at about one half of the gross produce.

Labour

128 . Cultivating Classes.- In all parts of the territory the actual cultivation is carried on by Christians, curumbis, savaias, marathas, musalmans, mahars and almost all castes of people including some Dravidian tribes. The Christian agriculturists predominate in the Velhas Conquistas while in the Novas Conquistas the other castes form the majority of the farmers. Most of these do not possess their own lands but cultivate them as tenants-at-will.

The cultivating classes are generally contented although they are not in affluent circumstances. Their daily food consists principally of rice and fish. This shows that their wants are very limited. Their mode of living is also too simple. A few earthen pots, wooden spoons, a few tin utensils, mats made of Lava ^(Typha angustata) or palm leaves for bedding form all their necessary equipment. Their dress is also quite simple.

The people from densely-peopled localities like Pariez, and Salcate work comparatively hard, whereas those in thinly populated talukas like Ponia, Satary are as a rule ^{more} ~~less~~ violent, because in such localities, there being no dearth of cultivable land, one can earn a living without such strenuous work. If the labourers have enough food to last for a couple of days, they will not go to work until that is exhausted, as a class they are free and not dependent.

A large proportion of the agriculturists of this territory particularly in agriculturally overstocked localities such as Pariez, Salcate, Pernem are unable to subsist only on the yield of the land of the locality in which they are born ^{and} live and so have to go out elsewhere in search of work. Most of them are engaged in agricultural work only for about 4 to 6 months of the year and therefore

many of them spend the rest of the period off and on in some occupation such as forest labour, carting, road-making, cutting stones, constructing buildings etc; some others work as carpenters, smiths, stone shavers, tailors, fitters etc.

When a large amount of work is required to be done in a short period, it is performed on a cooperative barter system. Hand weeding and reaping of rice are two operations which require much labour and the local supply in the intensively cultivated localities cannot cope with them. At the time of these operations the Gizalids, Marathas and other labouring classes go to such localities after finishing their own work. The labourers engaged in harvesting and threshing receive their wages in kind.

Capital

126. In the case of the cultivating classes the indebtedness is limited and within bounds and the loans are only short term. They have generally to borrow for the following purposes.

- (1) To tide over a season.
- (2) To purchase bullocks.
- (3) To meet expenses in connection with marriages etc.
- (4) To meet miscellaneous expenses in connection with food and clothing from the shop-keeper on credit.

The money lending business to tenants and landless is done by the proprietors, landlords and by the Posinkars, in the case of community lands. The usual rate of interest charged varies from 10 to 25 percent.

Part II.

Suggestions and Recommendations of Improvements.

Advertências e recomendações sobre os melhoramentos (a im- [Indica])

127. After thus ~~revising~~ reviewing the present situation and with the help of the experiments and investigations carried out by ~~me~~ I now come to the last and most vital part of my report namely the suggestions and recommendations of improvements. These I propose to deal with under the same headings as adopted for describing the present situation.

Chapter XIII

Improvement in Soils. *Melhoramentos dos solos.*

128. The study of the analyses of the soils described in the foregoing portion of the report indicates that most of the soils of Goa are deficient in organic matter as well as in other plant-foods. In most of the cases potash seems to be sufficient, but the chief deficiency is of nitrogen and phosphoric acid. The percentage of humus varies very much. Its presence is very important as the value of land mostly depends on the amount of humus present.

Sandy soils are usually poor in plant-food and are leachy. The main improvement of such soils consists in filling them up with organic matter and increase their retentivity. This can be done by the addition of organic matter, earth from fields or from hill sides or mud from rivers for which the territory presents an unlimited scope.

Soils containing a high percentage of clay are difficult to cultivate. When dry they bake very hard. The main treatment of a clay soil consists in reducing its heaviness. The addition of farm yard manure, green manure, leaves either dry or green, mud or lime, will lighten its heaviness and improve its structure and fertility.

Savelly or
loam soils.

129. These soils have very low water-holding capacity and they dry out quickly. Such soils can be improved by

adding organic matter, either by adding foliage at the time of ploughing or by occasionally growing green manure crops (like san (crotolaria juncea) or niger seed) and ploughing them. The practice of applying river ~~silt~~ silt is good and should be encouraged. River silt adds humus, clay and lime and thus increases the fertility and capacity of the soil to hold water.

110. Improvement of the present basis of rice lands, terracing, levelling and bunding the machini lands on the open slopes of hills will increase the productivity by stopping erosion and thus retaining silt in the fields to a certain extent.

Chapter XIV.

Improvement in Water Supply.

Measures para o aproveitamento da agua.

111. At present almost all tanks and reservoirs are owned and managed by the village communities. Large amounts are annually spent on repairs and maintenance of these institutions, but still one finds that the tanks are almost always more or less leaking. The seepage and percolation of water from tanks means so much loss of water, without being utilized for irrigating the crops.

112. This leakage could be stopped by properly repairing the tanks and requiring ^{the} prompt attention. It is essential that the Administrator of community lands should exert himself to see that the work is properly done. For the present it is, I believe, entirely left to the Junta of community lands without any supervision.

113. Considerable amount of water is at present wastefully used by the farmers. The water is simply allowed to run from field to field during night until it reaches the last plot from whence it runs away into the adjoining ^{Nalas} ~~streams~~ or rivers.

184. If the cultivators use the community-tank-water with care, with which it has been provided to them, the results would be much better. Certainly more area could be covered with various crops provided the water is used economically and also the seepage from the tank is prevented.

closing of
tanks during
irrigation
periods.

185. Every year an amount of money has to be spent on closing the mouths of the tanks and reservoirs. This is usually done by placing in the stone slits, small pieces of trunk of betelnut palms and coconut palms and filling the empty space with loamings of trees, rubbish and earth to make it water tight. This annual recurring expenditure to the community could be saved if plank shutters of a permanent nature are provided with a contrivance for lowering the level of the planks as the water level in the tank goes down. Under the present arrangement any body can go and remove the pieces and take water as he pleases. When it is of a permanent nature, the doors could be closed and locked and the key kept with the man who has the management of the irrigation from the village tanks. Similar arrangements should be made in the Nova Conquistas to build up the stream by some masonry work with openings left to be closed with planks when required.

Distribution
of water.

186. There is no arrangement for proper distribution of water to the cultivators who have lands situated at rather high and low levels. Generally water flows with great velocity towards the low level channel and the farmer whose lands are above suffers from want of water. He is required to hold the water at some high level to facilitate its flow over his land. This is usually done by putting temporary mud lands, which could be easily cut by small jerks of feet while going over the channel. This is what usually occurs and many farmers break each others heads over it. In order to avoid this better the community should provide a contrivance by which the water could be easily flooded when required for irrigating the upper lands,

By
say/inserting a piece of a plank, in the construction,
which will divide the water-current into two or more divi-
sions according to requirements. The water flowing over
the plank will run into the channel leading it to low lands.

In places, it is found that the current of water is
divided into several flows by passing them through several
short diversion-bunds. Here the divisions are intended for
different irrigators, but the distribution of water does not
seem to be uniform and could be easily tampered with by
anybody.

The distribution could be improved upon by fixing a
log of wood horizontally in the channel, so that all water
will flow over it uniformly. If in this piece of wood
vertical divisions are made by insertion of suitable pieces
of planks, it will divide the total flow into any number
of proportionate parts, according to the number of shares
to be irrigated from each channel.

Introduction
of new water-
lifting
machines and
types.

127. The Balsar Water Lift.- This lift is an improve-
ment over the Persian wheel.

Comparative trials were made on the Katnapiri and Kunta
farms and recorded by the Deputy Director of Agriculture,
Konkan Division, on page 27 of the Katnapiri Farm report for
1915-16 and on page 48 of the Kunta Farm report for 1912-20
are very interesting and instructive and are given below:-

"Messrs. Chelabhai Chhotabhai Dayabhai & Co. of Balsar
District Surat have been manufacturing the bucket pumps on
the model of Lorias. These are more compact, strong and
durable than the local Persian wheels and are said to be
more economic of power required. One of these with one
million buckets was fitted on the Katnapiri Farm and com-
pared with the local Persian wheel. The following are
the comparative results that were obtained:-

| Name of the lift | Cost | Depth at which worked. | Capacity per hour | Power required as furnished by engine | Remarks |
|---------------------|------|------------------------|-------------------|---------------------------------------|--|
| Local Persian wheel | 50 | 30 | 900 | 50 | One Can last for about 4 years with annual cost of Rs. 2 for repairs. |
| Pulsar Bucket Pump | 800 | 20 | 2400 | 100 | Two Can last for about 15 years with annual cost of Rs. 10 for repairs. |

It would be seen that this bucket pump requires comparatively less power to lift the same quantity of water as by the local Persian wheel, and is to be recommended where there is sufficient water in the well and sufficient area under irrigation to use up all the water lifted in a day."

The Pulsar water lift was tested under Kanara conditions. One and a half gallon buckets were used. A discharge of 2500 gallons per hour was obtained from a depth of 24 feet. A pair of bullocks could work the water lift. The local counterpoise bucket hand lift can raise about 800 gallons of water per hour from the above depth. Thus the work of the Pulsar rahat with three units (two buffaloes and one driver) of labour is equal to that done by five units with the hand-bucket-lift. So it would be an economic water-lift where there is sufficient water supply and area to be irrigated i.e. equal to the capacity of five hand-bucket lifts.

Main Pump . 126 Main Pump . - In this year an endless chain carries wooden blocks with leather washers at an interval of about a foot. It passes through a pipe and then over a crooked

wheel to which handles are fixed for working the lift. The pump is portable. It is useful, when the area to be irrigated is small. It can be worked to a depth of water varying from 8 to 10 feet and can raise 2500 to 3000 gallons of water per hour. It requires four men; two men in relays at a time. The pump costs Rs. 50 to 75. The ordinary lat draws 600 to 1500 gallons of water per hour. Two men are required to work in relays.

109. Archimedean Screw.- It is very efficient for low lifts up to 8 feet. It consists of a cylinder, one end of which is made to dip under the surface of the water. Within the cylinder there is a spiral work, the effect of which is gradually to screw the water upwards when the cylinder is rotated. It is worked by one man easily. The heavier machines will require two to three men to work. It discharges 1500 gallons of water per hour. The machine costs Rs. 35-40.

110. Power Pumping.- For irrigating large area (about 15 acres and above) oil engine and pump would be economical, provided there is plenty of water supply. The experience seems to show that unless the engine can be kept at work for at least four hours every day of the irrigating period, it will not be worth while to instal an engine. The oil engine consumes kerosine oil and does not require much attention after it is once started. Even an intelligent farm-labourer can learn easily to drive and work the engine. To have some knowledge about the work of an oil engine and pump the following details will be found useful. These have been calculated for a depth of water about 25 to 10 feet.

B.H.P.

| | |
|--|----------|
| 5 H.P. Oil Engine (continuous) | Rs. 2200 |
| 3" centrifugal pump. | Rs. 400 |
| Fitting charges including beltline, wiring etc. | Rs. 600 |

The life of the machinery may be put down at 14 years, and so the annual depreciation comes to Rs. 244

Interest on Rs. 1400 at 6% Rs. 305

Rs. 449

Daily working expenses (working time 10 hours)

Cost of 40 lbs of kerosine at Rs. 4/-/-
per tin of 40 lbs. at the rate of
1/2 pint per brake T.F. per hour. Rs. 4-10-0

Lubricating oil. Rs. 0-7-0

Cotton waste. Rs. 0-1-0

Witter. Rs. 1-0-0

Rs. 6-8-0

Assuming that the oil engine is worked for 8 months in a year, the daily charges on account of depreciation and interest etc amount to Rs. 449
240

If to this the daily working expenses (Rs. 6-8-0) are added the total working expenses per day come to Rs. 6-0-0

A 3" Centrifugal pump has a capacity of discharging 180 gallons per minute from a depth of 20 feet so the quantity of water discharged amounts to 180 x 60 x 10 i.e. 108000 gallons per day equal to 480 tons equal to 4 1/2 inches nearly. To have this much water, the daily working expenses and the labour charges for distributing water (two men at 12 annas each per day) together amount to Rs. 6-8-0 i.e. nearly Rs. 8-0-0 per inch of rainfall.

Alkali soils.

141. The alkaline soils are unfit for growing until they are treated. There are two methods of improving such soils. The most common and efficient way of removing salts is to irrigate the land with fresh water and drain it. The field should be divided into small compartments with good, strong fairly tall lands with trenches all round to receive drainage. Irrigation washes the salt out of the soil and drains carry it off.

Chapter XV.

Improvements in Implements.

Abbetteramentos nas alfaias agrícolas

142. Although the present implements perform their work with more degree of efficiency, and although they are cheap and very easy to mend if anything should go wrong, still the labour problem and the cost of production are questions which are getting more and more serious than ever before. People from Goa are emigrating to British India and Africa, as they obtain better wages in manufacturing cities and towns. The cheapness of labour in India is not a thing of the past. Now-a-days the labour conditions have altogether changed. The daily wages have trebled from 4 annas to 12 annas per day during the last decade. Thus the same conditions which obliged the westerners to adopt labour-saving appliances in their country are now gradually coming over in India. Tillage operations are carried out poorly and good lands are likely to lie waste for want of labourers.

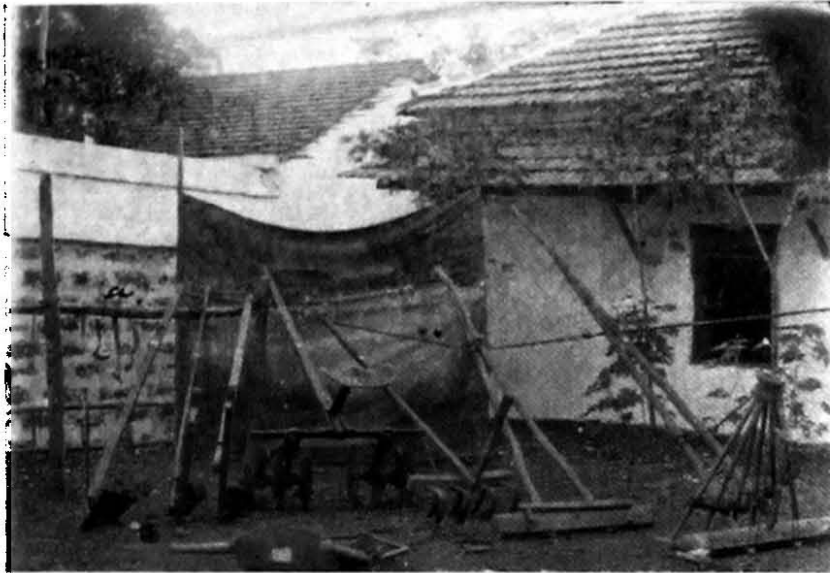
Grinding and rice hulling mills and sowing machines have already come into use on account of high wages and labour-saving implements ought to take the place of the present laborious and inefficient ones in agriculture also.

The aim for using labour-saving appliances is to enable the farmer to cut down his farming expenses, get out better work and increase his profits.

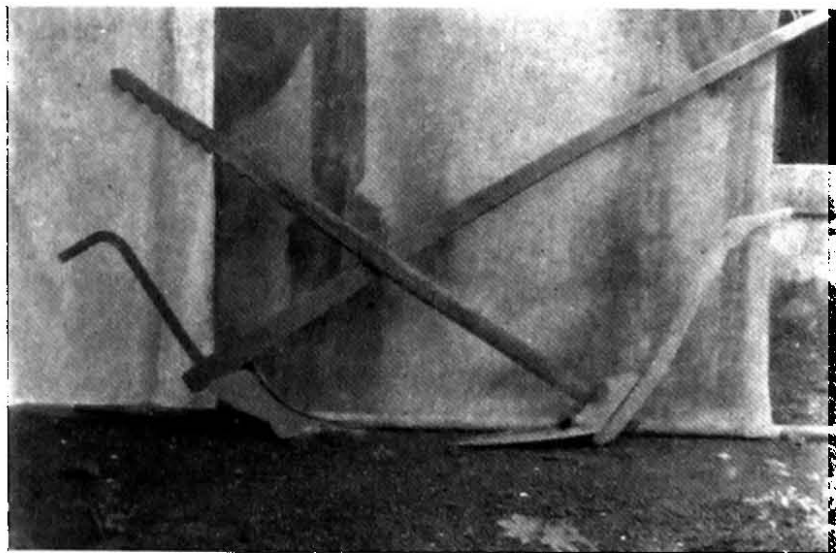
143. Owing to the small and unbalanced nature of rice-fields, small plots of land which each individual cultivates, poor cattle and poor economic condition of the cultivator, the improved implements must be fairly cheap and at the same time efficient. They must be simple in construction, so that they could be repaired in the village.

144. From the experiments carried out and experience gained by the writer during his period of investigations in

Illustrations - No. 2



*A. Group of improved implements: (a) Working
hooks (b, c, d) Iron ploughs (e) Disc Harrow (f)
Iron leveller (g) Rice land puddler (h) Deccan harrow
(i) Karnatak Rice-drill.*



(B). (a) Eureka plough (b) Indigenous plough

Now it has been found that the following improved implements could be used with advantage in Coa agriculture:-

1. Light iron ploughs.
2. Disc harrow and ~~disc~~ ^{Aene} harrow.
3. Ordinary Deccan harrow.
4. Rice land Filler.
5. Six-coulters' rice drill.
6. American five coulters' clipper drill.
7. Ordinary Deccan weeding hook.
8. Rice Thresher.
9. Winnow.
10. Iron leveller (Fetari)

Some of these implements can be purchased directly by the cultivators, some can be bought on cooperative basis while others can be purchased by the landlords and proprietors of large holdings and then hired out to their tenants (Vide Illustration No. 2)

Iron Ploughs.

145. Out of the several types of light iron ploughs, Eureka and Weston have been found to suit the conditions of Coa. Both of these can be worked by one pair of bullocks and having one handle can be worked in the same manner as the indigenous plough. These make a rectangular furrow which is rather wider and deeper and with the mould board which they possess, turn and crumble the soil and thus bury the weeds and grasses underneath. They completely cut the soil and do not leave any unploughed ribs between the furrows as is the case with an indigenous plough, which opens only a V shaped furrow and thus save the cross ploughing required by the latter.

"Eureka" has been found to do good work on sandy soils. It is a land-side plough. It works fairly well on baroli and low lying rice lands in the laterite tract (Fonia - Panjora). It is also useful in ploughing between the coconut trees. It is fairly light and easy to work but it

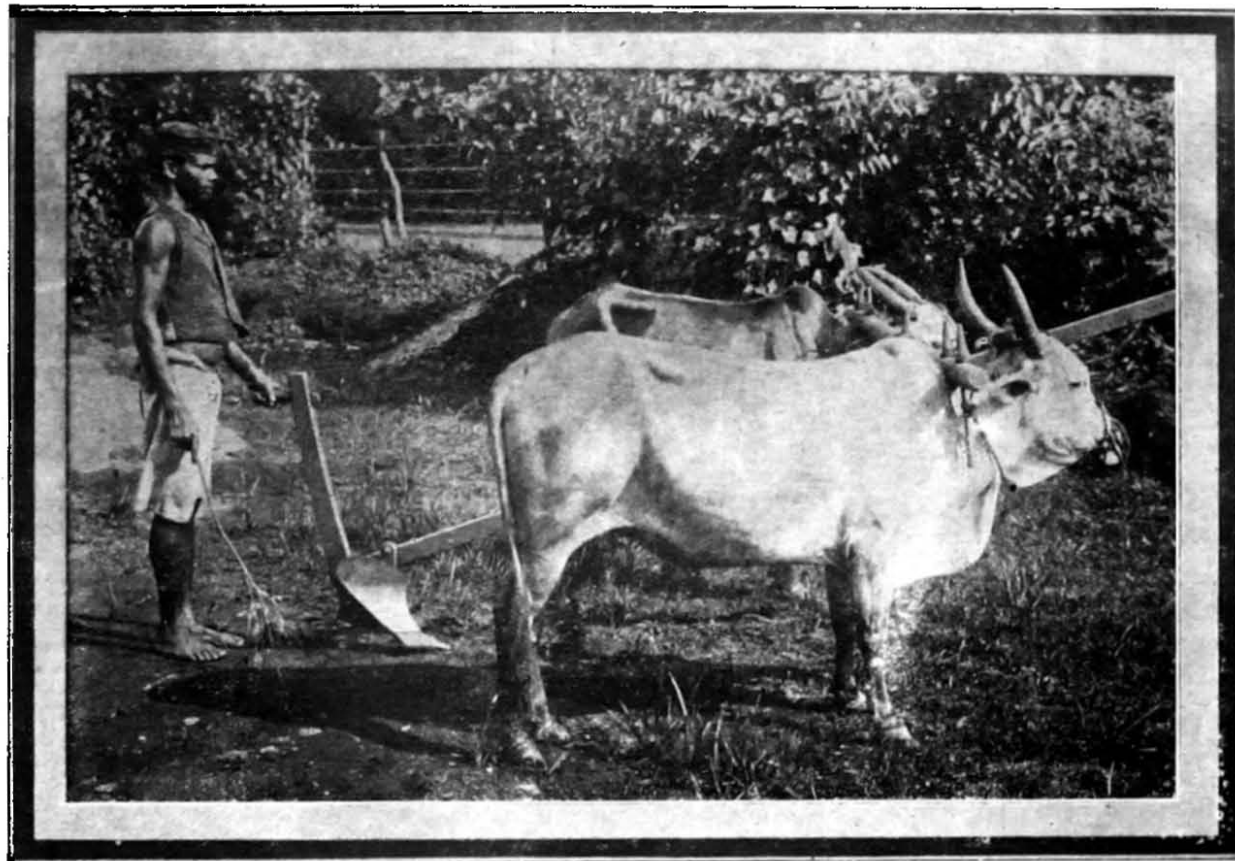


Illustration No. 3

Mestera p. 100

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"Balodyan Press, Poona."

requires a little stronger ~~4/4/~~ animals. It has a double board and a double-edged share. When one point is used up, the share is simply turned over and re-used. Shares can be renewed or sharpened. It ploughs a little over $\frac{1}{4}$ of an acre per day in sandy soil and about half an acre in clayey soil as against 16 guntas of the indigenous plough. The plough costs about Rs. 16 at Marcao (Salcete). It weighs about 22 lbs. It is manufactured in the Training Institute of Solar, South India, Mysore. (Vide Fig. ^{B(a)} ~~2(a)~~ the Illustration No. 2)

Beston

This is comparatively a lighter plough than Marcao and has been found to do good work in ploughing and pulling out sandy and clayey rice-fields. It is specially suited for Marolia. The plough costs about Rs. 12 at Marcao. Beston ploughs are manufactured by Messrs. Farn & Co., Calcutta and can be obtained from the Union Agency, Bombay. Similar ploughs under the name of 'Konkan' are manufactured by Kirlokar Brothers, Ltd., Miralshiradi, District Satara (Vide Illustration No. 3) and figure (A) of the illustration No. 4)

During the period of my investigation in Goa the ploughs were demonstrated in several places and were met with appreciation. In all 42 ploughs have been bought in 20 villages of the territory, the Salcete³ village of Parica having taken the largest number viz. ten.

Other ploughs.

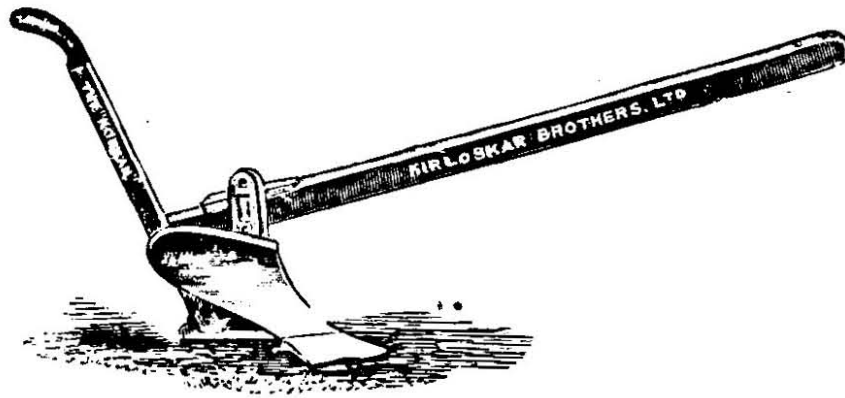
146. No other ploughs which will satisfactorily and economically negotiate with the peculiar conditions of Goa have yet been known.

Harrow.

147. The principal object of this implement is to break clods and fine the soil turned up by the plough. There are several types of this implement. The most useful are the disc harrow, the cone harrow and the beccan bladed harrow.

Disc harrow- This harrow consists of two sets of round rolling discs, each set containing three or more discs. A

Illustration No. 4



(A) Kirloskar plough.

By courtesy of Kirloskar Brothers.



(B) Disc Harrow.

"Balodyan Press, Poona."

six disk harrow was tried on the Penaulia Farm and has been found to work very satisfactorily with a pair of bullocks on sandy soil as a substitute for the plough when the soil is fairly dry. It does four times the work of the plough. In order to completely stir and break clods from the soil, the discs should be set slanting so that they will enter the soil at a wide angle. Such a disc harrow costs over a hundred rupees (vide ^{Fig. 4 of the} illustration No. 4)

Acme Harrow.- This implement has knives that have been tried. The knives first cut the soil, then raise, & turn over and pulverise it. It leaves the soil nearly level. The Acme harrow costs about Rs. 70.

This implement was tried on the Ratnagiri Agricultural Station for ruffling. The Deputy Director of Agriculture, Konkan, remarks on page 70 of the Report for 1916-17 to 1918-20.- "The Acme harrow has been found to replace the plough for doing the latter part of tillage, viz. ruffling with much advantage in that it prepares a finer ruffle and does thrice as much work as the plough."

Light Iron Harrow.- This very simple iron tined implement which is commonly used in the Deccan for dry cultivation has been found to be admirably suitable for ruffling rice fields. It does work two or three times as fast as a plough. The weight of the light plough is about 10 lbs and costs Rs. 6 to 8. This was worked very successfully on the Penaulia and Pandora Farms (vide Fig. ^(A) of the illustration No. 2)

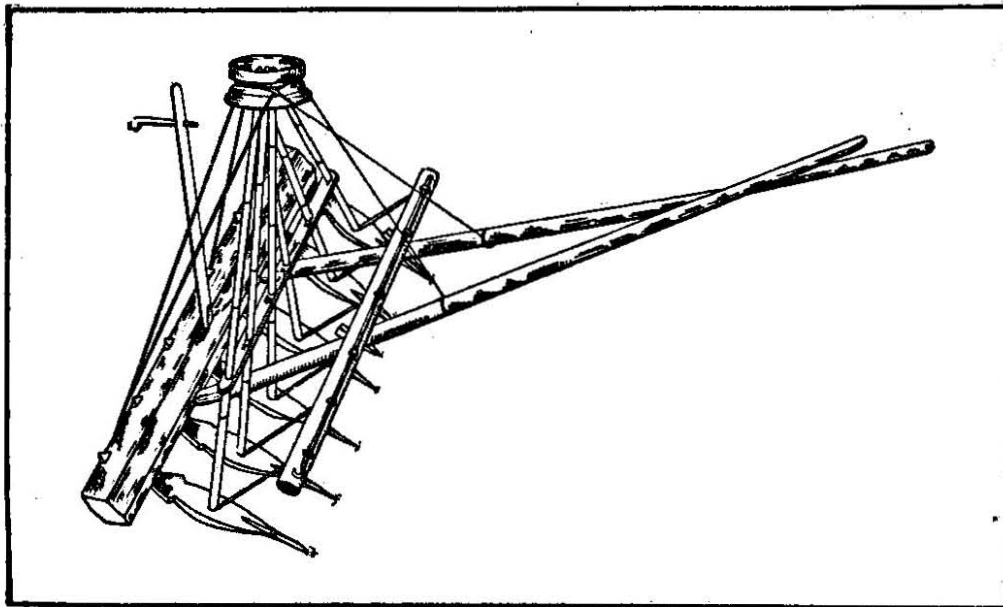
Light Iron
Rullers.

148. This implement is made on the type of a rake. It consists of a strong frame to which are attached in two lines six iron teeth, descending obliquely downwards and forwards. All the teeth enter the ground at an angle. This implement ruffles the soil fairly well. It was tried on the Penaulia and Pandora farms. It costs about Rs. 10 (vide Fig. ^(B) of the illustration No. 2)

Illustration No. 5



(A) American - 'blipper' drill.



(B) Carnatak Rice drill.

"Balodyan Press, Poona."

Six coulters
Rice Drill.

149. In the heavy rainfall tracts of Belgaum and Charnwar a six coulters drill is used for sowing rice. It consists of a head-piece generally made of teak (*Acacia arabica*) which gives attachment to all other parts. Into the head piece six coulters are fixed in a slanting direction. The coulters have holes about the middle and are shot with iron. The bamboo tubes are adjusted vertically on the holes of coulters until they join in the seed-bowl. The seed bowl is usually made of wicker wood and fitted on the top end of the tubes. The pole about 8 feet long is fixed about the middle of the head piece and the stilt on the top which is used while lifting the drill at turnings. All the parts of the drill are tightened by attaching a rope to the neck of the bowl and stretching in both the directions in front and behind. While sowing, a bar is kept behind the bowl for holding seed (Vide ^{Fig. 14 AB of 14E} illustration No. 5). One drill can sow 2 to 4 acres per day. The price of the drill is about Rs. 6 to 8.

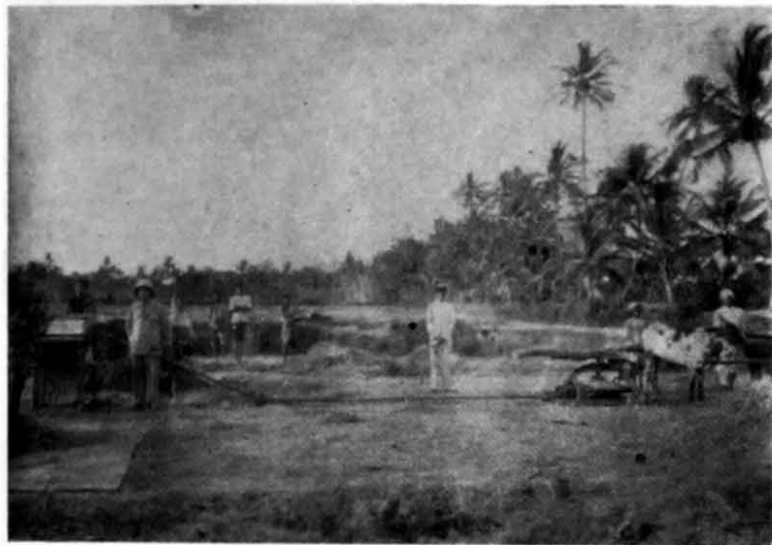
The drill method of sowing can be introduced where Yoko and Tassen methods are in vogue. It will economise labour to a considerable extent and would also secure the removal of weeds by bullock implements.

American Five
Coulters
Climax Drill.

150. This is an automatic seed drill worked by a pair of bullocks. The seed is once for all filled in a hopper placed on a frame. The machine is so constructed that when the hitched bullocks begin to work, the seed begins to drop through the coulters uniformly and regularly all along in a continuous row the seed rate being adjustable as required. The drill costs about Rs. 60 (Vide ^{Fig. 14 A of 14E} illustration No. 5)

To work this drill a skilled sower is not necessary. The even distribution of seed takes place automatically and the work done is about five times cheaper than the Yoko and Tassen method.

Illustration No. 6.



(A) Bullock power Rice Thresher.



(B) Front view of the Thresher.

"Balodyan Press, Poona."

Primary Paccan
weeding Hook

151. In Goa there is no really weeding hook for removing larger or smaller weeds. All must be pulled out by hand. Stirring the surface soil in vegetable garden lands is done by sticks or with fingers. There are various kinds of small tools for this purpose. The operation of working this tool removes weeds, loosens the surface soil and makes a fine mulch and thus conserves moisture. It partly earths up the plants. This hand tool will be of great use in weeding fields sown during the advent of the monsoon and in vegetable cultivation. The weeding hook costs from 6 to 8 annas (Vide Fig. (2) of the illustration No. 2).

Rice Thresher.

152. In the year 1921-22 H. and S. Patent Thresher, manufactured by Hentley Graham & Co., London, was tried at the Fandulim Farm, near Margao. The thresher was worked by bullock gear. The present price of the machine varies from Rs. 400 to 500 inclusive of bullock gear. A pair of ordinary bullock work the gear admirably. To work the machine two men and four women are required. Under ordinary conditions the machine could thresh 5000 to 6000 lbs of paddy per day of 8 hours at a cost of Rs. 2-12-0 whereas the same quantity (6000 lbs) would cost Rs. 11-4-0 when threshed by human labour (Vide ^{Fig No. A and B of the} Illustrations No. 6 ~~12-11~~ and ~~12-12~~ ^{Fig A & B 7}).

Winnowing.

153. When rice or any other grain crop is threshed, it is required to be winnowed and cleaned. Sometimes for want of breeze men have to wait for hours. When the wind is favourable the work done is even quicker than the machine. When there is want of breeze, some artificial breeze has to be produced by shaking faniri (mat) or the woven leaf of cocconut. But this cannot be done for a long time.

For producing an artificial breeze there are machines called winnowers which are fitted with 3 or 6 sieves having different sized meshes for different kinds of seeds. Winnowers are worked either by hand or by some power. In the

Rice Tullage Mills of Goa, the winnowers are worked by
 rover. When the handle of the machine is turned, the fans
 as well as the sifting sieves begin to move simultaneously
 As the sieves move the grain with chaff is to be poured on
 the hopper, it falls on the sieves where grain, chaff and
 other rubbish are separated. Grain falls down on one side
 while the chaff is blown away by the gust of wind.

The price of the ordinary small winnower is within
 Rs. 100. Winnowers are light and can be moved easily from
 place to place. The winnower will be specially useful to
 a large estate owner (~~vide illustration No. 13~~)

Iron Leveller.
(Fetari)

154. In the rice tract, a lot of levelling is re-
 quired to be annually done. Rice beds are ploughed or hand
 dug in the fair season; the clois are taken for repairing
khuis and filling up inequalities in the beds. In the
 hilly tract terracing, making new embankments and repairing
 old ones need a good deal of earth to be carried from one
 place to ~~Y/Y/Y/~~ another. Ordinarily this work of carrying
 earth is done in baskets which needs a large number of
 labourers. There are indigenous implements for doing this
 kind of levelling work but they are inefficient.

The iron leveller does the work more economically. It
 does the work of 10 to 12 men at each turn. It is some-
 thing like a scoop. On each side of the scoop there are
 iron hooks which give attachment to the bent iron-frame,
 which ~~g/g/g/g/g~~ connects the scoop to the yoke by means of a
 rope. On the sides of the scoop there are two wooden
 handles for manipulation. The soil of the field is first
 ploughed and loosened. The scoop is taken to the higher por-
 tion of the land slightly raised by the handle, so that the
 sides cut into the soil and gets filled. It is dragged
 full of earth to the hollow or depression which has to be
 filled up, emptied and brought back for refilling. There are
 two bars of iron fixed to the bottom of the scoop, which
 prevent the sheet iron from wearing out. Fetari is worked
 by ^a pair of bullocks and costs Rs. 10 to 13 (~~vide~~ ^{Fig. (3) of 152} Illustration No. 9)

Chapter VII.

Improvement of the Manure Supply.

Present supply
insufficient.

150. According to the cattle census of 1917 there are about 90,000 (68201 cow type and 21860 buffalo type) cattle in the Goa territory in addition to 34411 pigs. Taking large and small animals together 90,000 cattle will produce 270,000 cart-loads of farm yard manure at the rate of three cart-loads per head per annum. The approximate area under rice in the Goa territory is estimated at 84880 Hectares or 84840 acres (1 hectare = 2.47 acres)

Taking the whole of 270,000 cart-loads (1 cart = 800 lbs. as available for application to raily fields which is certainly not the case, it works out at about 3 cart-loads per hectare or about 3 per acre which is quite inadequate to produce a successful crop of raily.

A large quantity of cowdung, however, goes to manure the betelnut gardens and turning into ashes which are required to be mixed with the rice seed while sowing. Not an inconsiderable amount of which is used also as fuel.

Fertiliser cowdung, quantity of fish, rice-brand etc. are available in this territory. In some years the fish harvest is plenty while in others there is a general scarcity.

Considering all the above sources together the present supply is found to be much too short of the requirements.

Improvement in
the present
sources of
conservation.

156. Improvement in the existing sources of manures:-

Before dealing with the possibility of finding new sources of manures it is essential to see whether the present sources could not be increased or improved upon.

The commonest source of manure within the reach of every cultivator is farm-yard manure. It supplies all the most important ingredients of plant food. But the methods of conservation followed in Goa leave much to be desired.

The manure is preserved in a pit. But it is kept in such a way as to lose a great portion of its value. The pit is soaked with water during the rains or scorched by the sun in the hot season. In this way some valuable substances are lost with the water and some fly off into the air. If manure is kept saturated with water it cannot undergo the necessary changes to convert it into food for plants. The manure pit should therefore be roofed over and precautions should be taken that the rain water from the surroundings does not flow over the pits. When the dark brown liquid is allowed to escape from the manure pit, it carries with it nearly all nitrates and potash. To prevent this, manure should be kept in a pit with a water-tight bottom made by ramming clay or by putting on cement. When the manure is overheated the nitrogen is lost in the form of carbonate of ammonia. To prevent this loss the manure heap should be kept moist by adding water.

In Canacona and in some places at Satary the cultivators add dry leaves to the manure heap. It is a good system of increasing the bulk of the manure and is recommended to be followed in places where green or dry leaf is available.

157. Urine.— The most effective manure obtainable is the urine of man and beasts. It is almost entirely lost although it is far more valuable and available than dung. Of the total nitrogen contained in the droppings of animals $1/3rd$ is found in cow dung and $2/3rd$ in the urine; of the total potash $1/5th$ is found in cow dung and $4/5th$ in urine and the phosphoric acid is mostly found in the cow dung and only in traces in urine.

158. The system of conserving cattle urine by absorbing it in sand followed by some farmers in the coastal tract, of human urine in Paries as referred to in the Chapter VIII on the present manure supply are commended for general --

attention. The sand used for absorbing cattle urine may also be substituted by loamy soil, grass, dry or green leaves, vegetable waste etc.

189. Another way of conserving urine is to lead it into the manure pit and for this purpose the floor should be well rammed with ^(decayed rock) MURUM and should have a gentle slope to catch all the urine that will fall from cattle which will eventually run into a gutter and finally collect into a vat specially constructed at the end of the gutter. The urine from this vat should be daily removed on to the manure heap or when convenient the gutter may be made to open into the manure pit directly. This addition will greatly enhance the value of manure.

190. The method of folding cattle which is followed to some extent in almost all parts of Ceylon is a good system and is worth being generally extended. For farmers having few cattle an improvement in the system after the Jaffana method is possible.

191. The Jaffana (Northern portion of Ceylon) method consists of a 2 feet square block, the sides of which are made up of planks of wood $1\frac{1}{2}$ feet high on all sides. This frame has four standards at the corners which support the thatched roof. The fodder is thrown on the ground inside the square which has at times a false bottom. The cattle are tied to the rees which are fixed in the ground just touching the frame. There is only one ree on each side of the frame; so by this method four cattle stand separately under one roof. As the fodder is thrown in, it does not come under their feet and get soiled. The cowdung and urine fall in situ and directly manures the land. The whole frame is moved from place to place until the entire plot is manured.

192. Improvements in burning land.- In places where dry branches of trees and bushes are burnt, the soil of the

field is not ploughed before sowing of branches. But if this could be done, the effect of burning the soil would be very much enhanced. The method could be further improved by allowing the manal to burn slowly. This can be brought about by covering the manal with fine soil and wetting the surface before starting fire.

Few Sources of Manures.

163. Very often people from Goa enquire about the artificial manures, as farm yard manure is insufficient and the supply of fish manure is uncertain and irregular. Everyone is aware that farm yard and such other organic manures act on the soil in two ways; they supply plant food and at the same time, improve the texture of the soil by constantly adding much vegetable matter. Fertilizers such as oil cake, fish, bone-meal and artificials like sulphate of ammonia, nitrate of soda, sulphate of potash etc., which chiefly supply direct plant food in a readily available form, cannot fulfill the function of the manures, viz. keep-
ing up the texture of the soil for which green manuring and addition of leaves tender branches of trees and any animal or vegetable refuse are the substances which ought to be used.

164. Night Soil.— Human excreta forms one of the most valuable general manures containing about twice as much as plant-food ingredients and the same quantity of humus as in farm-yard manure and in a very readily available form. The average output per day per capita has been computed to be 6 ounces of solid excreta and 40 ounces of urine. Goa has a population of about 5 lakhs and the enormous quantity of manure obtainable can easily be calculated. All the night soil obtained in Goa cannot be made use of for manure. In the coastal tract it is used for fattening pigs.

Night soil from Farsia could be profitably utilised in villages, which are situated about 8 miles away from the

higher lands and transferred to the fields at the time of rainfall.

In the case of machini which is generally transplanted or sown late in the rainy season there is sufficient time for growing and ploughing in a small crop of green manure, if early opportunity is taken for broadcast sowing and by the first shower of rains. In the case of sugarcane it could be very easily grown and ploughed in.

168. The following are the suitable crops for green manuring:- Sun (*Crotalaria juncea*), velvet bean, *Mitha* (*Melilotus albus*) and niger seed (*Aeschynomene indica*). In Andhra and Bengal *Leucaena* (*Sesbania aculeata*) is recommended for green manuring of rice lands and may be found useful in Coa.

Green manuring with sun and addition of *Mitha* (*Melilotus albus*) and *rai* (*Calotropis gigantea*) leaves have given good results with rice on the sandy soils of the Panadla farm, and with *Mitha* on the farm at Panora (India).

Manuring with green or dry leaves and *Leucaena* has, however, a great scope for application on a much larger scale, as the country abounds in wild vegetation. Rice hulls which is available in large quantities in Coa has been found to be of advantage in manuring paddy lands.

169. Oil-cakes.— They are the residue from oil seeds after the extraction of oil. They are a quick-acting nitrogenous manure, the effect of which lasts for one or two years after their application. They vary in composition from 3 to 7 percent of nitrogen. Oil cakes are rarely used in Coa for manuring purposes; those that are sparingly used in certain places being Sesamum (*Hydrocarrus vietniana*) and rai (*Calotropis gigantea*).

170. Oil cakes are very useful for irrigated garden crops, such as sugarcane, plantains, ginger and other market vegetables. They have given good results on the rice crop

town. The field for application should be ploughed well, clods broken and soil made fine. When this is done it should be divided into long wide beds (of about 6 feet) and ridges in such a way that the night soil cart can enter the bed without breaking the side ridges. As the cart passes through the bed, the night soil is dropped in quantities, spread well and immediately covered over with earth from the ridges. All the odour will disappear in a week or so. In this way field after field could be manured and rented out to tenants by the Municipality. The fields once manured by this method will remain fertile for 2 to 3 years.

165. In China and Japan night-soil is applied to the crops in two ways. In one case, the night soil is mixed with dry earth in the house and then taken daily to the field for application. The mixing of night soil with the earth is in vogue in every house in Ceylon and is also practised in England in out of the way villages.

The other method consists in the daily removal of night soil to the field and then storing it in wooden tubs with the addition of water for fermentation. It is ready for application in about 10 days. Before application it is mixed with 3 to 10 times of water and then applied to the standing crop in 2 or 3 doses according to requirements.

166. Other Sources of Bulky Manures.- Sweepings from towns and villages, earth dug out annually from road side cutters and horse-lime which are all available on some scale, also form valuable sources.

167. Green Manuring.- Green manuring is a very suitable and cheap form of enriching the soil with organic matter and also nitrogen/ in the case of leguminous crops. But the growing of such green manures has only a very limited scope in Cey. In places where the transplanting method of growing rice is practised, and could be grown on

higher lands and transferred to the fields at the time of sowing.

In the case of manure which is generally transplanted or sown late in the rainy season there is sufficient time for growing and flowering in a small crop of green manure, if early opportunity is taken for broadcast sowing soon after the first shower of rains. In the case of sugarcane it could be very easily grown and ploughed in.

168. The following are the suitable crops for green manuring:- Sun (*Crotalaria juncea*), velvet bean, *Andropogon* (*Andropogon villosus*) and niger seed (*Azadirachta indica*). In India and Bengal *Andropogon* (*Sesbania aculeata*) is recommended for green manuring of rice lands and may be found useful in Ceylon.

Green manuring with sun and addition of *Andropogon* (*Andropogon vasicola*) and rui (*Calotropis gigantea*) leaves have given good results with rice on the sandy soils of the Panvelin farm, and with *Andropogon* on the farm at Panora (India).

Manuring with green or dry leaves and lowines has, however, a great scope for application on a much larger scale, as the country abounds in wild vegetation. Rice hulls which is available in large quantities in Ceylon has been found to be of advantage in manuring paddy lands.

169. Oil-cakes.— They are the residues from oil seeds after the extraction of oil. They are a quick-acting nitrogenous manure, the effect of which lasts for one or two years after their application. They vary in composition from 5 to 7 percent of nitrogen. Oil cakes are rarely used in Ceylon for manuring purposes; those that are sparingly used in certain places being Jostea (*Hydrocarrus vietniana*) and oil (*Calothyrium inchoyllum*).

170. Oil cakes are very useful for irrigated garden crops, such as sugarcane, plantain, ginger and other market vegetables. They have given good results on the rice crop

on the *Konkan* farms of British India, as well as in experiments carried out by the writer in Goa.

171. There is a very good scope for extending the use of oilcakes in the Goa territory. There is a good deal of coconut and sesarun cake already being made and used mostly for feeding. All damaged and decayed rancid cakes which are unsuitable for feeding can all be used for manurial purposes. The growing of Castor, oil and Karanj trees which yield oilcakes should be extended. Karanj trees thrive in the proximity of water (streams) and could be extended all over, along the banks of sweet water rivers, streams and rivulets.

172. Under the Chapter of New Crops it has been shown that castors and groundnut can be grown in Goa. These crops will yield oil-cakes which could be used as manure.

173. Several kinds of oil-cakes can also be easily imported from Bombay and the Southern Maratha Country. The composition of the various cakes is given below and the choice should be made according to the quantity of nitrogen they contain.

| Kind of Cake | Nitrogen Percent. |
|------------------|-------------------|
| Safflower cake | 6.85 |
| Groundnut cake | 7.75 |
| Coconut cake | 5.81 |
| Sesarun cake | 6.61 |
| Rice seed cake | 4.47 |
| Cotton seed cake | 2.45 |
| Castor cake | 3.72 |
| Karanj cake | 5.75 |

174. Bones.— Bones supply about 4 percent of nitrogen, and about 24 percent of phosphoric acid and lime and also organic matter. Analysis of soils from Goa, show that there is a general deficiency of phosphoric acid. In order

to make up the deficiency bone meal should be largely used. When the bones are finely pulverised, its action is quicker on the soil. Bone meal has given good results of raihy almost everywhere along the Concan coast. It has also given good results on the Penzance and Bandora farms (vide experiments under rice). It is a valuable manure to cocconut and other fruit bearing trees and plants. Bone meal is available at Mulli (Cherwar district). During the last three years about 12 tons of bone meal was obtained from Messrs. W. Coen & Co., Mulli and used by proprietors in different parts of Con.

175. A number of cattle are slaughtered daily in the Velhas Conquistas. Their bones as well as bones of leaf animals are available in quantities in villages. If the Portuguese Government were to organise the collection and crushing of bones as a Government concern, it could make available a very valuable source of manure.

Bones when dry can be broken into small pieces under an ordinary mortar mill.

176. The bone manure can be prepared locally. A small pit about 3 or 4 feet deep should be dug according to the available quantity of bones. The broken bones and good soil should be put into the pit in alternate layers, each layer about 3" to 4" in depth, until the pit is filled. The mass should be kept moist by adding cattle urine and water. The bones will be decomposed and softened in about 6 months. When thus softened the mass should be taken out, turned over and raked well. Then it is ready for application to the soil.

Another method of softening the bones and raising the plant food contained in it available consists in putting layers in the pit in the following proportions:- Two baskets of broken bones, three baskets of slaked lime and six or seven baskets of ashes should be put into the pit in layers 1/1// until the pit is completely filled. The mass

should be finally covered with a layer of grass waste and fine loamy soil. The pit should be thoroughly saturated with water. The manure is ready for application in about 4 to 6 months.

157. Other animal refuse.- Blood (which contains 5 to 10 percent nitrogen) and bones and other refuse from slaughter-houses ~~wherever available~~ wherever available, are all useful and valuable manures to increase the fertility of the soil. For the present most of these are unused in India.

158. Artificial Fertilizers.- In order to get a larger output of produce and higher profits from the land it would very often be advisable to use artificial fertilizers.

Artificial manures are not yet generally produced in India. Sulphate of ammonia and nitre are manufactured in India to a certain extent. Most other artificials have to be imported from abroad and hence their cost becomes prohibitive. The only scope for artificials lies in the use of sulphate of ammonia for rice and sugarcane and nitrate of soda for onions.

Application of
manure.

159. Farm yard manure is not evenly distributed over the entire area. The effect of uneven spreading is clearly marked when the rice crop is starting in the field.

The manure should be evenly and thoroughly distributed and mixed with the soil, and not confined to narrow lines and spots. If farm yard manure is to be used economically and full benefit is to be obtained therefrom, the well-rotten manure should be spread broadcast upon freshly ploughed field and mixed in immediately.

160. The oil-cake manures should be rotted well before application. In the case of rice it may all be applied on the day of sowing, while in the case of sugarcane and garden crops they might better be used in two or three dressings.

181. The artificial manures should be pulverised and to secure even distribution their bulk should be increased by adding sand, fine earth, ashes etc. They should be spread broadcast and applied in small dressings. The first top-dressing should be after the crop is about 6 to 8 inches high. Artificiala should not as a rule be used singly but should supplement bulky manures.

The bone manure should be applied to the land a fortnight before planting the crop.

Chapter XVII.

Improvement of Cattle.

182. From the figures of agricultural live-stock given in the Chapter on the present state of live-stock and from general enquiries it seems that the number of cattle are not sufficient in the coastal tract and that they are just sufficient or little more in the sub-montane region. Moreover their condition is also exceedingly poor. The cultivation is therefore inefficient necessitating the use of a considerable amount of costly human labour which could otherwise be more profitably employed; the milk supply is very inadequate and in villages it is very hard to get any milk. The directions in which improvement of this state of affairs is possible are:-

- (1) Provision of good and sufficient food and fodder
- (2) Better breeding.
- (3) Better housing and care.

Whatever is possible to be done under each of the above heads in the Goa territory is summarised in the following paragraphs.

Feeding.

183. Although during the rains grazing and green grass are available in plenty the quantity of fodder available in the hot season is quite inadequate; the quality of rice straw and the dry grasses is exceedingly poor.

184. Ensiling. - A considerable portion of grass in hilly tracts either goes to waste or is cut when rendered over-ripe and coarse. If this could be cut at an early stage while in flower and stored in pits for turning into silage, a good quantity and quality of food could be made available for the fair season. The success which can be obtained for ensilage made in local silo is very strikingly illustrated by the results obtained on the Latnaciri farm as quoted below.

| Dimensions of the Pit | Method of filling | Quantity of green grass put in | Date of filling | Salt used | Date of opening | No. months being used after opening | Good Silage obtained | Spoilt silage obtained | Cost of filling | | |
|--|---|--------------------------------|-------------------------|-----------|-----------------|-------------------------------------|----------------------|--|-----------------|-------------------------------------|--------|
| | | | | | | | Quantity | Percentage of Total green grass put in | Quantity | Percentage of Total silage obtained | |
| | | Lbs. | | Lbs. | | Months | Lbs. | | Lbs. | Rs. & p. | |
| Circular with 3' diameter and 6½' deep | Tapering to a height of 5' above ground | 10400 | 7-9-1918 to 7-10-1918 | 15½ | 11-3-1919 | 12 | 5680 | 54.60 | 1148 | 16.60 | 5-12-3 |
| Do. | | 9000 | 3-10-1919 to 15-10-1919 | 8 | 13-5-1920 | 1½ | 8956 | 66.10 | 1000 | 11.10 | 3-6-6 |

* Report of the Experimental work of the Hatnagiri Agricultural Station from 1916-17 to 1919-20 (Page 107)

Silage may be fed upto a rate of 10 lbs to a working and 15 lbs to a milch animal per day along with dry fodder. A silo pit about 12' long, 5' broad and about 6' to 7' deep would supply sufficient green fodder to a pair of bullocks for about three months.

185. Hay Making.- Those who cannot afford to make ensilage, should try to cut the grass at an early stage while still in flower. Such dried grass is much more nutritious than the one cut after seed-formation and complete dryness.

186. Growing of Fodder Crops.- Lucerne (*Medicago sativa*) guinea grass (*Panicum jumentorum*), towar and shevari have been found to grow well under the Konkan conditions. -- Lucerne could be cultivated under irrigation during the fair weather. It is to be sown in October and cuttings taken almost every month till the end of May. On the commencement of the heavy monsoon rains the crop dies. The yields obtained on the Patnasiri Farm from year to year are given below:-

| Year | Yield per acre in lbs. |
|---------|------------------------|
| 1916-17 | 11170 |
| 1917-18 | (20660 (22740) |
| 1918-19 | (20960 (22660) |
| 1919-20 | (17320 (12660) |

The author of the report writes "The success with -- lucerne ought to materially help the solution of the cattle problem of the district in places where cheap irrigation facilities exist."

Guinea grass is a perennial grass which thrives on high lands in the Konkan tract as an irrigated or a dry crop. The yield per acre of green grass obtained from a dry crop at the Patnasiri Government Farm is given below:-

| | |
|---------|------------------------------------|
| 1916-17 | 20000 lbs. obtained in 2 cuttings. |
| 1917-18 | 29880 " " |
| 1918-19 | 38800 " " |

The report remarks "Guinea grass gives large amounts of yield of green fodder in 2 cuttings during the rainy season in the equivalent dry weight of which it surpasses all grasses so far tried. Though it does not give any appreciable yield in the fair season, still the stubble retains its life all through the hot season, which in about a month's time from the commencement of the following monsoon gives a very heavy luxuriant cutting when other natural grasses have hardly made a six inches growth."

Jovar is another fodder crop which is likely to -- succeed on high lands under Coa conditions. It was grown by the writer of the report during 1921-23 on a small scale at Barrão. It was sown early in June and was ready for cutting for fodder by the middle of August and for grain by the beginning of October. It grew to a height of about 6'. One man at Fonia had also grown Jovar for fodder. This crop grew well and furnished his cattle with very nutritious fodder. This crop would thus do quite well in Machini and other upland well-drained soils.

Shevari (*Setaria eseyrtica*) grows well ~~very~~ on high lands during the rains and supplies cuttings of nutritious succulent green fodder once in every two or three months. The detailed methods of the cultivation of the fodder crops can be found in Bulletin No. 100 of 1930 (Fodder Crops of western India) and also in special leaflet Nos. 6 of 1919, 22 of 1909 and 11 of 1915 of the Bombay Agricultural Department:-

157. Rations.- The following rations consisting of food-stuffs available in Coa are recommended for various purposes.

- (1) Pullock ration for one thousand pounds live weight
Bediant- 20 lbs. rice straw or 20 lbs. machini straw.
Feed- 5 lbs. rice bran, plus 3 lb. kulthi seed, plus
2½ lbs. niger cake or 1½ lbs. safflower cake
or 2 lbs sesamum cake.

- (2) For bill animals for one thousand pounds live weight
Bediant- 20 lbs. rice straw or 18 lbs. machini straw
Feed- 2 lbs. rice bran, 2 lbs. niger cake, 3 lbs.
cotton seed.

All animals should be provided with a little salt every day to keep them healthy and also to make their food tasteful.

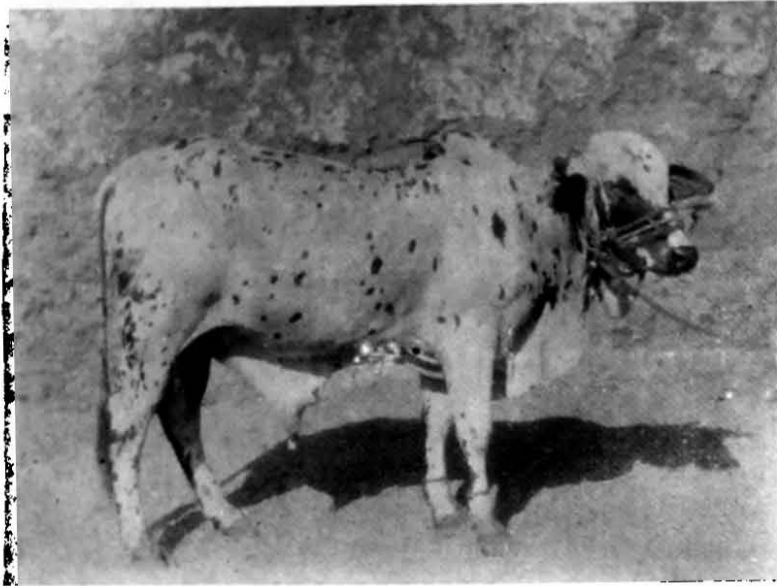
Breeding.

199. After the provision of good and sufficient food, the next measure by which cattle can be improved is by scientific breeding. Although professional breeders called Dhansars rear a large number of cattle and goats in the high hills of Dalay, Collem, Ganadana, the methods followed are not all scientific and a non-descript poor breed is the result.

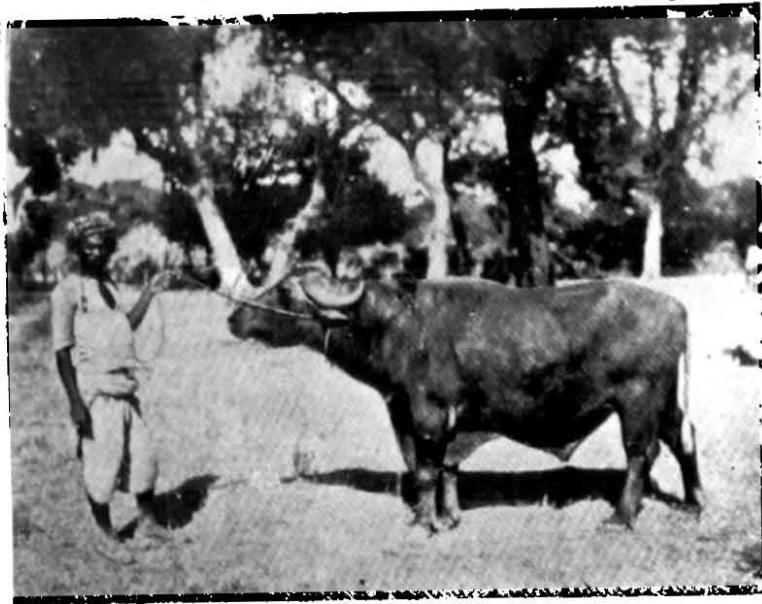
The first essential to improve cattle by breeding is the provision of good and suitable bulls. This can be achieved either (1) by directly importing bulls of suitable breeds from outside, or (2) by establishing cattle breeding farms in the territory itself. Then for the purpose of improving the breed throughout the territory, good bulls obtained in one or the other manner suggested above should be made available either through village cattle-breeding societies or by adopting the system of premium bulls followed by the Bombay Department of Agriculture the details of which are given in Appendix No. 2. The breeds that are recommended for introduction are Halskar of the Mysore state and Lanai of the Nasik district for bulls and

* The approximate weight of work cattle in Goa will vary from 500 to 700 lbs.

Illustration - No. 8.



(A) Dangi bull.



(B) Surti buffalo bull.

By courtesy of the Bombay Agricultural Department.

"Balodyan Press, Poona."

(wide illustration No 8)

Start for Buffalo's for milk purposes. The best course would be to establish a pure breed from the local cattle by selection and breeding. But this is a slow and extensive process.

The localities suitable for establishing cattle breeding farms are Satary and Sangpur where there are very good facilities for grazing and for raising fodder crops.

Along with the introduction of good and pure breeds, it is necessary to exclude the possibility of promiscuous mating of inferior bulls by early castration of all the village bulls.

Housing and Care

199. The condition of housing and taking care is not satisfactory. The floor of the cattle shed should be made of kharu, well rannel without any holes in them. The floor should slope towards the back of the cattle, so that all the urine will be carried into a gutter and through it into the manure pit.

A feeding trough should be provided in front of cattle, or at least planks should be fixed upright to the posts to which cattle are tied. If the cattle tyre is thus kept clean, by timely removal of contents and by sweeping it well, the cattle will remain free from ticks and other injurious vermins which trouble them.

200. Control of Diseases:- The cattle in Coa are found to be subject to epidemic diseases such as rinder-pest and haemorrhagic Septicemia, which at times take a large toll of them and foot and mouth disease which weakens them considerably and also other common diseases. Comprehensive measures for inoculation treatment and advice will largely help to prevent the large amount of losses occurring at times.

Chapter XVIII.

Improvement of Rice.

Present out-
turn of Paddy.

191. I cannot find better authority on statistics than Mr. Bernardino Danilo da Costa, Director of the Survey Department, and so I quote the figures of area under rice cultivation from his paper read at the fourth Provincial Congress which was held during 1921. The area under rice excluding Barão and São is as follows:-

| Name of Taluka | Area in Hectares. | Ratio of land to pop. | Production in Canis. |
|--------------------------------------|-------------------|-----------------------|----------------------|
| Ilhas | 6215 | 1 : 10 | 170,140 |
| Fonia | 2751 | 1 : 8 | 62,202 |
| Sanjuelia | 2018 | 1 : 6 | 44,404 |
| <u>Do Concelhos São Carlos e São</u> | | | |
| Salsete | 5750 | 1 : 10 | 104,020 |
| Parias | 3838 | 1 : 10 | 100,000 |
| Fernão | 2166 | 1 : 8 | 42,100 |
| Quarac | 1431 | 1 : 6 | 24,160 |
| Sanjuelia | 4781 | 1 : 4 | 6,875 |
| Satory | 625 | 1 : 4 | 6,110 |
| Sanjuelia | 2421 | 1 : 6 | 41,101 |
| Total | 24,285 | | 721,124 |

192. According to the above statement the approximate production of paddy at both the seasons comes to 721,124 Canis, which is insufficient for the maintenance of the present population. To make up the deficiency 410,126 Canis of paddy in addition are required to be annually imported. The question now arises, could this extra quantity of paddy be produced in Goa, if so by what means?

193. Then there is also the question whether by any means any economy can be effected in the present cost of production or the labour involved, so that the labour thus liber-

rate) can be utilized on increased production in other ways.

194. According to the investigations carried out by us, I think this can be achieved by the following methods. (1) Increase in the area under rice cultivation. (2) Extension of irrigation facilities. (3) Better cultural methods. (4) Better manuring. (5) Improvement in seed. (6) By more efficient methods of threshing and cleaning. (7) Protection of crops from pests and diseases. (8) Extension of the period of auction of the community lands.

195. A very interesting and instructive extract from a book on Agricultural Progress in Western India, 1921 (page 99) by G. F. Keatings, late Director of Agriculture, Bombay Presidency, is here given to show to what extent the increase in outturn is possible by better cultivation, better manuring and better seed.

"In Europe, statistics showed that during the past century the outturns of wheat and other cereals were doubled and the experts in various countries were asked to indicate the proportion of this 100 percent that could be ascribed to (1) improved and increased manure, (2) better tillage, (3) improved seed, (4) better rotations.

The causes of this improvement were assessed as follows:-

| | : England : Percent | : Germany : Percent | : France : Percent |
|----------------------|-------------------------------|------------------------|-----------------------|
| Improved manure | : Considerable | : 60 | : 60 to 70 |
| Improved cultivation | : Most of all | : 20 | : 15 to 20 |
| Improved seed | : 10 | : 15 | : 5 to 20 |
| Improved rotation | : Little except : indirect | : 10 | : - |

It will be noticed that manure secures the first place amongst the causes that have contributed to the increased yields. Next in order comes the improved cultivation. Improved seed comes third and even such limited advantages can be secured by seed seed, only when the cultivation and

manuring are adequate.

196. Similarly the same author on page 104 gives the same kind of percentages of crop increase, based on the experience obtained at the experimental farms in the Madras Presidency to show to what extent the yield can be increased by good tillage, adequate manure, sound seed and protection of land from surface washing."

| Determining Factor | Percentage of crop increase obtainable | | | |
|--------------------|--|--------|-------|--------|
| | Surat | Solemn | Poona | Barwar |
| Manure | 20 | 20 | 20 | 20 |
| Cultivation | 20 | 25 | 20 | 25 |
| Seed | 10 | 10 | 10 | 10 |
| Drainage | 10 | - | - | - |
| Field embankments | - | 15 | 15 | 20 |

197. The large scope for increasing the yield of rice can be gauged by comparing the outturns of rice in some of the best rice-producing countries of the world.

| Name of the country | Yield of rice per acre lbs. |
|---------------------|-----------------------------|
| Spain | 5700 |
| Italy | 2800 |
| Egypt | 2800 |
| Japan | 2100 |
| United States | 1400 |
| India | 820 |

(1) Increasing the area under rice cultivation.

198. According to Dr. P. J. da Costa the cultivated area which can be newly put down under paddy is 1206 hectares. Calculating on an average a yield of 20 cantia per hectare this area will be able to produce 24000 cantia or about 6 percent of the total deficit. In these regions immediate increase in cultivation and expansion cannot be expected. The expansion will only take place slowly as land is cleared and improved in various ways.

(2) Extension of irrigation facilities.

199. Goa is a land of rivers and mountains and certainly there are greater possibilities of constructing tanks and reservoirs in Goa than in any other district of the General tract. If this is done, then by making fuller use of the natural supplies of water the area under double cropping could be increased.

200. There are some tanks constructed in olden times, which have been in recent years neglected and many of them have consequently been silt up and have thereby become useless for storage of water. If these were put into order and more reservoirs constructed, the cultivator will also try to bring his field under varnana crop.

201. If old tanks are put into order by stopping all seepage and drainage, and if storage arrangements are made in places where natural springs are now flowing and partially used, certainly more area could be doubly cropped.

This kind of improvement cannot be rapid, because it requires funds.

By all such improvements of irrigation facilities put together, I am of opinion that an increase of production of the country by 10 to 20 percent can be effected.

(3) Better cultural methods.

202. These include (a) improvement in the preparation of the soil, (b) improvement in manure, and (c) improvement in the methods of planting rice.

(a) Improvement in the Preparation of Soil:- The fine tillage so necessary for the successful growth of crop is obtained by working the plough frequently. When the country plough works four inches deep, the furrow is about 8 inches wide at the top and about 1 1/2 inches at the bottom so that even if the plough be worked well under favourable conditions, there would be left portions of earth untouched by the plough and therefore the plough has to be worked several times (say 5 to 6 times) for thorough working of the soil. Because the conditions allow but short periods

For preparing the soil, it is important to employ methods by which the work can be got done as expeditiously and economically as possible. The improved ploughs described in detail under the section of implements have been shown to do this work in about half the time required by the present indigenous implements and moreover uproot weeds and turn them over in mulch, which helps their early rotting. The next operation after ploughing is to harrow the land well. This also can be more economically done by working the ordinary wooden harrow two or three times.

203. In the coastal tract the practice of *ayroo* upturning the land by the hoe is commonly met with. The work is laborious and needs a good number of labourers at a time when their time is most urgently required for threshing of rice, *hiccine* and ploughing between coconuts etc. The *Bureka* plough has been found to do this work with about one-third the labour required for hand *hiccine*. These labour-saving implements were tried on the *Pennaulin* and *Paniora* farms during the Varsana season of 1921 and 1922-23. The soil was ploughed twice and the harrowing was done by a couple of harrowings, which would require 6 to 6 ploughings with the indigenous implements. The economy thus effected can be seen from the experimental results tabulated below:-

| Area in square Metres | Name of cultural treatment | Expenditure for preparation of soil upto sowing. | Cultures | | | |
|-----------------------|---|--|----------|-------|-------|-------|
| | | | Crain | Straw | Crain | Straw |
| | | Rs. Rs. P. | lbs. | lbs. | lbs. | lbs. |
| 400 | Cultivated with improved implements | 1 13 0 | 193 | 193 | 200 | 164 |
| 400 | Hand <i>hiccine</i> and indigenous implements | 5 6 0 | 160 | 168 | 160 | 181 |
| 400 | Indigenous implements | 13 10 0 | 174 | 180 | 160 | 156 |

204 (1) Improvements in Bunds- Good bunds which will help in holding sufficient water are essential for rice cultivation. The annual scouring has encroached on them to such an extent, that the size of the bunds have been considerably reduced and in some places it only represents a division between two consecutive compartments. These bunds should be sufficiently broad and strong, at least a width of a foot or more is quite essential. If the bunds are good and in order, various kinds of pulses and vegetables could be grown on them, in high-lying areas. In the Kelata and Patnairi districts of the Konkan and Belgaon of Karnatak, bund crops are quite common in rice-areas. Dal, kharif, tur, udil, moor, jowar, choli are the usual crops grown.

Extension of the transplanting system in growing rice:-

205. (c) Improvements in the methods of planting rice.- It has been stated under the system of growing rice that transplanting is carried on only on a very small scale in Goa. It is a generally known fact that transplanted rice always yields more than the sown crops besides causing a saving in the quantity of seed. Of course, transplanting can be best practised in low lying fields over-saturated with water. It is estimated that about one-third of the total area under rice or over 10000 hectares are suitable for transplanting and the saving in seed alone would amount to 6850 canis annually. It is also expected that the increase in yield may amount to about 10 percent or equal to 20 thousand canis.

206. One point against transplanting that must not be lost sight of is that it requires more labour in a short period. But by the labour-saving methods discovered from time to time it should be possible to make it available. In places where plough and lagga methods of sowing rice are followed, the use of a seed-drill would be more economic in respect of both time and labour required for sowing and

weeding. A hectare of land which requires five men, 20 women and 10 bullocks for a day can be finished off with 1 man, 1 woman and 2 bullocks in the same time.

(4) Fertilizer
Manures.

207. Chemical analysis as reported under Part I, shows that many rice lands in Goa are deficient in available plant food. Ordinarily the cultivators apply some cattle manure, ashes and rice husk mixture to the low lands and wherever possible salt and river mud and sometimes cowdung to high lands. To the second crop (Vansana) some cowdung, ashes and fish are applied according to availability. The availability of these manures may not be even enough to half of the paddy area annually cultivated. Other manures must be found out. The cultivators are fully aware about the utility of manures, but they are ignorant of other possibilities than those that they are accustomed to.

208. In the Chapter on improvements in the manure supply these various sources have been pointed out in detail. The most important of these which have been found to be profitable for rice by experiments in Goa or in other parts of Konkan similar to Goa are described in the following pages.

209. Experiments at Penaulim (Salcete) and Pandora (Tantia):-

The Penaulim farm-soil was representative of the coastal tract being capable of growing two crops a year (Kharif or Sorghum and Vansana). It is sandy in character, with a subsoil of similar composition. The Pandora farm soil was a representative of the clayey soil obtained in the hilly tract.

210. The following table shows the composition of the farm soils at Penaulim and Pandora.

| | Fenaulis Farm. | | | | | | Faciola Farm. | |
|-------------------------------------|----------------|--------|--------|--------|--------|--------|----------------|--------|
| | soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil |
| | from | from | from | from | from | from | from | from |
| | Plot | Plot | Plot | Plot | Plot | Plot | Plot | Plot |
| | No. 5 | No. 20 | No. 23 | No. 25 | No. 28 | No. 24 | No. 17 | No. 27 |
| Moisture | 0.20 | 0.26 | 0.14 | 0.18 | 0.16 | 0.13 | 10.90 | 15.90 |
| Loss on ignition | 1.74 | 1.86 | 1.86 | 2.00 | 1.12 | 1.12 | | |
| San | 95.04 | 94.88 | 95.75 | 95.10 | 96.00 | 96.09 | 98.04 | 98.48 |
| Lime (CaO) | 0.16 | 0.16 | 0.28 | 0.28 | 0.22 | 0.22 | 0.45 | 0.45 |
| Potash | 0.11 | 0.10 | 0.19 | 0.07 | 0.03 | 0.06 | Not determined | |
| Proanthric acid (FeO ₃) | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.21 | 0.22 |
| Nitrogen | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.08 | 0.11 | 0.24 |

Fenaulis Farm:- All the samples are poor in FeO₃ and nearly fair in Nitrogen. Samples Nos. 1, 2, and 3 are fair in Potash but Nos. 4, 5 and 6 are poor in Potash.

211. The manurial experiments were divided into Green manures, lucky manures, concentrated manures and intract manures.

212. Green Manures.- These consisted of growing a san (*Protolaria juncea*) crop and ploughing it in, and incorporation of the green leaves of rai (*Salicornia bicantia*), aijla (*Ajlatoda vasica*) and Lexi into the soil before sowing. At Fenaulis San was sown broadcast in the plot and when the crop was a month old it was buried in the soil by ploughing. San did not grow well. The height of the crop was about a foot when buried. Germination was fair, but the water logged condition of the land did not allow it to make fast growth.

Rai leaves were secured from open ground at Marcao and aijla from fences round about the houses and Lexi from the hills near Marcao. The results obtained were as follows:-



Illustration No. 2

Son Rui
Green manured plots.

"Balodyan Press, Poona."

| Area in square metres | Manurial treatment | Quantity | Panajir | | | Panjora | | |
|-----------------------|----------------------|----------|-----------------|---------------------|-----------------|---------------------|-----|----|
| | | | Actual Cut-turn | Proportion of yield | Actual Cut-turn | Proportion of yield | | |
| | | lbs. | Grain lbs | Straw to seed lbs | Grain lbs | Straw to seed lbs | | |
| 400 | San crop ploughed in | - | 216 | 216 | 18 | - | - | - |
| 400 | Rui leaves | 270 | 202 | 201 | 16 | - | - | - |
| 400 | Mulda leaves | 400 | 202 | 201 | 16 | 213 | 240 | 26 |
| 400 | Mulda + bone meal | 400+30 | - | - | - | 246 | 400 | 29 |
| 400 | Levi | 400 | 151 | 241 | 15 | - | - | - |
| 400 | Unmanured | - | 152 | 152 | 10 | 156 | 170 | 18 |

213. The effect of the application of green matter in the three forms experimented with are marked and such more so in clay soil of Panjora. The rui leaves are available in quantities in the coastal tract and the mulda is a common fence plant round about the houses and especially so in the hilly tract. The farmer can collect these leaves during his spare hours and they cost him nothing. In the case of san it is only the cost of seed amounting to Rs. 13-8-0 per hectare which will be his out of pocket expenses. (*vide illustration No 9*)

214.- Bully manures.- The experiments in this series were undertaken to determine and demonstrate the value of several manures obtainable in Panjora. The experiments with their results are recorded below:-

Illustration No. 10



(A) (a) Ashes

(b) Cowdung



(B) (a) Horse dung + salt.

(b) Rice Hulls.

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| Area in square metres | Manurial Treatment | Cost of Manure | Actual | | | Outturn | | | | | |
|-----------------------|--|----------------|--------|-------|-------------------------------------|--|---|-------------------------------------|-----|-----|----|
| | | | Grains | Straw | Frover- tion of yield sown | Faniora representing soil of the region | Faniora representing clayey soil region of the hilly tract | Frover- tion of yield sown | | | |
| Kind | Quantity | lbs. | lbs. | lbs. | lbs. | lbs. | lbs. | lbs. | | | |
| 400 | Rice June | 150 | 2 | 0 | 0 | 122 | 125 | 11 | 222 | 200 | 24 |
| 400 | Co-june | 200 | 0 | 4 | 0 | 166 | 162 | 12 | 222 | 260 | 19 |
| 400 | Horse- dung + 200 lbs. cow- dung | 64 | 0 | 6 | 0 | 189 | 211 | 15 | 220 | 240 | 18 |
| 400 | Co-june | 400 | 0 | 8 | 0 | 168 | 189 | 14 | - | - | - |
| 400 | Rice bran | 400 | 3 | 8 | 0 | 232 | 201 | 18.5 | 292 | 200 | 24 |
| 400 | Horse- dung + 200 lbs. cow- dung | 200 | 0 | 10 | 0 | 194 | 172 | 16 | - | - | - |
| 400 | Co-june + 25 lbs. horse dung | 75 | 0 | 1 | 0 | 181 | 168 | 15 | 220 | 260 | 21 |
| 400 | Unmanured | - | - | - | - | 151 | 135 | 12 | 156 | 170 | 12 |

75 lbs.
 215. In the above experiments co-june 74// plus horse
 23// 25 lbs. represents the local practice of manuring.
 Taking this as a standard for comparison, the only results
 worthy of note are that rice bran and rice June give a be-
 lievable increase in outturn amounting to about 15% in the
 soil at Faniora and about ²³4% percent at Faniora. (vide illustration
 10/10)

The adverse results at Faniora for rice June which took
 place in that plot are due to washing.

At present rice husks are not considered of such
 manurial value. This manure must have produced immediately
 a mechanical effect than a chemical one.

The results further prove that the value locally attrib-
 uted to rice husks is true and wherever horse dung is avail-
 able it is in no way less effective than co-june.

316. Concentrated Manures.— Under this head various kinds of oil-cakes and fish were under trial. Oil-cakes are not used for manurial purposes in Coa. Manures applied in this series were on the basis of 50 lbs. of nitrogen per hectare. The ~~the~~ results are tabulated below:—

| Area in acres | Manurial Treatment | Treatment: | | | Actual Output. | | | | | | | | |
|--------------------|--------------------|------------|------------|------------------|--|--|-------|-------|------------|-------|-------|------------|---|
| | | Kind | Quantity | Cost of Manure | Penasala Farm re- presenting sandy soil of the coastal region | Penasala Farm re- presenting clayey soil region of the hilly tract. | Grain | Straw | Fertilizer | Grain | Straw | Fertilizer | |
| Plot | | | lbs. | Rs. | lbs. | lbs. | % | lbs. | lbs. | % | lbs. | lbs. | % |
| 400 | Fish | | 25 | 13 5 4 | 196 | 265 | 16.2 | 215 | 260 | 27 | | | |
| 400 | Castor cake | | 50 | 13 3 0 | 214 | 277 | 15 | 236 | 400 | 29.7 | | | |
| 400 | Karanj cake | | 50 | 13 4 4 | 169 | 233 | 14 | 160 | 270 | 10 | | | |
| 400 | Safflower cake | | 50 | 13 11 8 | 216 | 244 | 15 | 222 | 260 | 26.6 | | | |
| 400 | Coconut cake | | 65 | 16 0 0 | 174 | 207 | 14.5 | - | - | - | | | |
| 400 | Groundnut cake | | 50 | 12 4 11 | 186 | 184 | 13.5 | - | - | - | | | |
| <u>Duplicates.</u> | | | | | | | | | | | | | |
| 400 | Fish | | 25 | 13 5 4 | 215 | 224 | 16 | - | - | - | | | |
| 400 | Castor cake | | 50 | 13 3 0 | 184 | 177 | 15 | 244 | 200 | 22 | | | |
| 400 | Karanj cake | | 50 | 13 4 4 | 154 | 177 | 15 | 200 | 260 | 22 | | | |
| 400 | Safflower cake | | 50 | 13 11 8 | 210 | 210 | 17.5 | 250 | 270 | 20.5 | | | |
| 400 | Mustard cake | | 75 | 2-2-4 | ----- | | | 200 | 270 | 21.0 | | | |
| 400 | Coconut cake | | 65 | 16 0 0 | 168 | 202 | 14 | ----- | | | | | |
| 400 | Groundnut cake | | 50 | 12 4 11 | 172 | 175 | 15 | ----- | | | | | |
| 400 | Coconut + fish | | 75 + 25 | 10 1 0 10 3 0 | 191 | 168 | 15 | 256 | 200 | 21 | | | |
| 400 | Emmenanthe | | - | - | 168 | 152 | 14 | 120 | 144 | 10 | | | |

Sandy good soil

Comparatively poor soil

N.B.:— 1. All cake manures were applied 15 days before sowing and only fish manure the day before.

Illustration No. 11



(A) (a) Karanji cake

(b) Safflower cake



(B) (a) Groundnut cake

(b) Bone meal

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2. Sweet cakes attract crows and other birds and therefore they should be incorporated into the soil as early as possible.
3. In this section the irregularity of the results at Penaulin are partly due to levelling of the land and partly to the presence of injurious salts especially present in duplicates.

~~* When it is brought to a certain level the soil and any surplus water can be put in the remark column.~~

217. From the above results it can be seen that fish and all cakes excepting cocconut have done fairly well at Penaulin and very well at Paniera. Out of these fish and Penan cake on a very small scale are locally available. Penan, castor and Kapani are bitter cakes and they act to a certain extent as a preventive against insects. The cocconut cake though locally available is used for feeding cattle and hence it is costly for manurial purposes.

The increases at Penaulin are not however sufficient to leave much profit after paying the additional cost for the manures used. But at Paniera they amount to from 23 to 40 percent over the local manure plot and leave some net profit. It has also been noticed that the residual effects, particularly of cakes are very great without any additional cost of manure in the succeeding two or three seasons. *(vide illustration No 11)*

218. Artificial Landre Series.- In this series the artificials with cow-dung and artificials alone were tried separately. The results appear below:-

| Fertilizer Treatment | Soil of | | | | Total | Actual | | | | Growth. | | | |
|----------------------|---------|----------|-------------|-----------|-------|--------|----------|-------------|-----------|---------|----------|-------------|-----------|
| | Soil | Moisture | Temperature | Structure | | Soil | Moisture | Temperature | Structure | Soil | Moisture | Temperature | Structure |

| | | | | | | | | | | | | | | |
|-----------------------------|-----|---|---|----|---|----|----|-----|-----|------|-----|-----|------|--|
| Soilure | 150 | 0 | 3 | 0 | | | | | | | | | | |
| Super-phosphate | 10 | 3 | 5 | 8 | 4 | 1 | 10 | 231 | 142 | 19.5 | 256 | 260 | 31 | |
| Ammonium Sulphate | 5 | 1 | 0 | 0 | | | | | | | | | | |
| of Potash | 4 | 0 | 9 | 3 | | | | | | | | | | |
| Soilure | 100 | 0 | 3 | 0 | 2 | 8 | 8 | 186 | 146 | 15.5 | 250 | 250 | 28 | |
| Super-phosphate | 10 | 3 | 5 | 8 | | | | | | | | | | |
| Soilure | 150 | 0 | 3 | 0 | 1 | 3 | 0 | 198 | 148 | 16.5 | 250 | 250 | 34.0 | |
| Ammonium Sulphate | 5 | 1 | 0 | 0 | | | | | | | | | | |
| Soilure | 150 | 0 | 3 | 0 | 0 | 12 | 2 | 175 | 165 | 14.5 | 240 | 250 | 20 | |
| Super-phosphate | 10 | 3 | 5 | 8 | | | | | | | | | | |
| of Potash | 4 | 0 | 9 | 3 | | | | | | | | | | |
| Fon-gesl | 20 | 1 | 4 | 10 | 1 | 4 | 10 | 215 | 255 | 17.0 | 300 | 300 | 28 | |
| Super-phosphate | 20 | 7 | 0 | 11 | 7 | 0 | 11 | 191 | 157 | 15.0 | 257 | 250 | 31.0 | |
| Ammonium Sulphate | 10 | 2 | 0 | 0 | 2 | 0 | 0 | 170 | 194 | 14.0 | 300 | 400 | 25 | |
| Fice manure of Union Agency | 20 | 1 | 0 | 0 | 1 | 8 | 0 | | | | 324 | 350 | 27 | |

Replicates.

| | | | | | | | | | | | | | |
|-------------------|-----|---|---|----|---|----|----|-----|-----|------|-----|-----|------|
| Soilure | 150 | 0 | 3 | 0 | 4 | 1 | 10 | 245 | 260 | 20.4 | 250 | 270 | 27.0 |
| Super-phosphate | 10 | 3 | 5 | 8 | | | | | | | | | |
| Ammonium Sulphate | 5 | 1 | 0 | 0 | | | | | | | | | |
| of Potash | 4 | 0 | 9 | 3 | | | | | | | | | |
| Soilure | 100 | 0 | 3 | 0 | 2 | 5 | 2 | 215 | 174 | 12.5 | | | |
| Super-phosphate | 10 | 3 | 5 | 8 | | | | | | | | | |
| Soilure | 150 | 0 | 3 | 0 | 1 | 0 | 0 | 210 | 277 | 19.0 | | | |
| Ammonium Sulphate | 5 | 1 | 0 | 0 | | | | | | | | | |
| Soilure | 150 | 0 | 3 | 0 | 0 | 13 | 2 | 204 | 191 | 17.0 | | | |
| Super-phosphate | 10 | 3 | 5 | 8 | | | | | | | | | |
| of Potash | 4 | 0 | 9 | 3 | | | | | | | | | |
| Fon-gesl | 10 | 1 | 4 | 10 | 1 | 4 | 10 | 192 | 170 | 15.0 | 240 | 260 | 20 |
| Super-phosphate | 10 | 4 | 1 | 10 | 4 | 1 | 10 | 205 | 214 | 17.4 | | | |
| Ammonium Sulphate | 10 | 2 | 0 | 0 | 3 | 0 | 0 | 190 | 201 | 14.0 | 300 | 350 | 25 |
| Soilure | 75 | 0 | 1 | 0 | 0 | 4 | 0 | 181 | 160 | 15.0 | 234 | 260 | 21 |
| Super-phosphate | 25 | 0 | 3 | 0 | | | | | | | | | |
| Manure | - | - | - | - | | | | 180 | 184 | 11.0 | 170 | 144 | 10 |

* Ordinarily measured plot.

Illustration No. 12.



(A) Cowdung + N + P + K

(b) Cowdung + Sulphate of Ammonia



(B) (a) Superphosphate

(b) Sulphate of Ammonia

- N.F. 1. The area under each treatment was 400 square metres
 2. All artificials were applied as top dressing 13 days after sowing.
 3. Bone meal and cowdung were applied first.
-

319. It will be seen from the above statement that the complete manure plots at Pondicherry show high yields, but not so on clay soils at Fanjora when compared with the ordinarily manured plot. Considering the cost of manure it is only the bone meal and Sulphate of ammonia that will be paying. Artificial in combination with cowdung has increased the yield to some extent, but is not profitable. Sulphate of ammonia when applied alone does not show any marked advantage on sandy soils of Pondicherry, but on the clay soils of Fanjora, has been responsible for a large increase of over 80 percent over the ordinarily manured plot; when in combination with cowdung, the sulphate seems to act better in the case of sandy soils. (*vide Illustration No 12*)

The advantage due to Bone meal is about 17 to 20 percent on both the soils.

The rice manure mixture of the Union Agency which was tried only at Fanjora has also given very promising results.

320. Indirect manures.— In sea salt is generally applied to higher or lagoon lands. This manure as well as lime were tested on the sandy soils represented by Pondicherry and clay soils at Fanjora but no striking results were obtained.

321. Manurial Experiments of the Natnagiri Farm.— Some useful and instructive results obtained on the Natnagiri Farm from the use of manures such as urine leaves, rice hulls and urine earth are given below:—

| Kind of manure | Treatment under experiment | Yield of paddy per acre | Yield of straw per acre | Remarks |
|----------------|----------------------------|-------------------------|-------------------------|---------|
|----------------|----------------------------|-------------------------|-------------------------|---------|

Lava Land.

1917-18

| | | | | |
|------------------|----------|--------|--------|---|
| Ful leaves: 5000 | : 15 3 0 | : 1520 | : 1240 | : On account of great beneficial effect of manure, the Deputy Director of Agriculture, Konaan Division, is recommending the starting of plantations of paddy on high lying areas not far from rice lands. |
| No manure : | - | : 1040 | : 1640 | |

1918-19

| | | | | |
|------------------|-----------|--------|--------|--|
| Ful leaves: 5000 | : 20 10 0 | : 1800 | : 2600 | : On high lying areas not far from rice lands. |
| No manure : | - | : 1320 | : 2560 | |

1919-20

| | | | | |
|------------------|-----------|--------|--------|--|
| Ful leaves: 5000 | : 20 10 0 | : 2400 | : 2700 | : On high lying areas not far from rice lands. |
| No manure : | - | : 2560 | : 2240 | |

Kala Land.

1916-17

| | | | | |
|------------|-------------------|--------|--------|--------|
| Fine earth | Produce : | | | |
| | for 10 bullocks : | 5 14 5 | : 1100 | : 2160 |
| | for 20 bullocks : | | | |
| | for 30 bullocks : | | | |

| | | | | |
|------------------|---------|--------|--------|--|
| Fine earth: 5000 | : 3 0 0 | : 1650 | : 2000 | |
| No manure : | - | : 1080 | : 1720 | |

1917-18.

| | | | | |
|------------------|-----------------|--------|--------|--|
| Fine earth | : 40 as above : | : 1940 | : 2340 | |
| Fine earth: 5000 | : 3 0 0 | : 1250 | : 1600 | |
| No manure : | - | : 1040 | : 1600 | |

228. The Deputy Director of Agriculture, Konaan Division recommends for upland or level rice lands the following quantities of manures:-

| | For acre |
|-------------------|------------|
| Fish | - 400 lbs. |
| Fish cake | - 700 lbs. |
| Ammonium sulphate | - 100 lbs. |
| Superphosphate | - 224 lbs. |
| Salt. | - 400 lbs. |

227. Improvement in burning methods.— In order to derive the full benefit from the action of burning under the Jalan method, the nursery should be ploughed once or twice, the clods well crushed and well levelled before arranging material on the bed. When this is done a layer of fine earth is spread on the mass to weight it down. Before setting fire to the nursery bed a small quantity of water should be sprinkled to make the material burn slowly. This method is practised in some parts of British India, and has been found superior to the method described under ordinary cultivation.

Where owing to the deficiency of burning material the Jalan method cannot be followed it has been found by the Bombay Agricultural Department that the same effect can be produced by the use of fish, oilcake, and ammoniac sulphate as can be seen from the following results:—

| Kind of Treatment | Quantity recommended | Cost for one month | Area that can be planted from one month's seed | Ratio of output to input | Remarks | |
|---------------------|----------------------|--------------------------------------|--|--------------------------|---------|--|
| ried fish | 100 | Rs. 40 | 140 | 7 | 105 | |
| oil cake | 50 | Rs. 40 | 140 | 7.75 | 100 | Almost all oilcakes are alike, in action and the one which has the most effect, at a particular locality should be chosen. |
| sulphate of ammonia | 12 | Rs. 12 | 130 | 6.5 | 107 | |
| guatrette | 12 carts | Rs. 20 | 130 | 6 | 100 | |
| fine earth | 12 carts | Labour of spreading + removing earth | 130 | 6 | 25 | |

228. Use of manure The two most commonly used rates are given below:—

| | | | | | | |
|-------------------|---|-------|-----|-----|-----|--|
| on June rat | 100 cattle dung 100 coarse grass 100 fine grass | Rs. 0 | 130 | 6.5 | 100 | * This mostly represents cost of labour, when the dung is obtained from one's own animal, this is not cost of pocket expenditure |
| Only branches rat | 500 branches | Rs. 5 | 130 | 5 | 70 | * This is only the cost of labour, in the case of one's own labour on his own land, it is not cost of pocket expenditure. |

Improvement in seed.

224. Reduction of seed rate.- The results of experiments carried out at Ponnalim and Pondera are set out in the following statement as well as those conducted on the Cuttack Agricultural Station quoted below are very clear in showing that about half the seed rate produces the same or larger yield.

| Area in Sq. metres : | Seed rate : | Actual Cuttarn | | | |
|----------------------|---------------------------|----------------|-------|--------------|-------|
| | | Ponnalim Farm | | Pondera Farm | |
| | | Grain | Straw | Grain | Straw |
| | | lbs. | lbs. | lbs. | lbs. |
| 400. | Full (1.00) (one cutav) | 149 | 189 | 166 | 160 |
| 400 | 1/2 seed rate (1/2 cutav) | 146 | 169 | 160 | 160 |
| 400 | 1/4 seed rate (1/4 cutav) | 239 | 295 | 184 | 210 |

Results of experiments on the Cuttack (Ponnal) Agricultural Station.

| Quantity of seed in bush (1 bush = 2 lbs.) | Cuttarn per acre in pounds of 50 lbs. | | | | | | Remarks |
|--|---------------------------------------|--------|--------|--------|--------|--------|---|
| | 1905 | | 1906 | | 1907 | | |
| | Grain | Straw | Grain | Straw | Grain | Straw | |
| 40 seeds per bush | 26 1/2 | 40 1/2 | 18 1/2 | 16 | 22 1/2 | 42 1/2 | The results of three years show that there is no need to sow more than 40 to 45 seeds of really well selected grain per acre in the broadcast cultivation." |
| 35 seeds per bush | 25 1/2 | 40 1/2 | 18 1/2 | 16 1/2 | 21 1/2 | 44 1/2 | |
| 30 seeds per bush | 25 1/2 | 40 1/2 | 16 1/2 | 26 1/2 | 22 1/2 | 41 1/2 | |
| 25 seeds per bush | 25 | 18 1/2 | 15 | 21 1/2 | 30 | 39 | |

225. Selection of seed.- It has been mentioned that no particular care is exercised in the selection of seed. But a few places have a special reputation for Mangana seed; thus phiric grown at Curtoria is preferred in Salute taluka and that from Panchsadi in other places. Corti seed from Sura (North Kanara district) is also imported by the Ponia and Sansuex people.

226. It is generally recognized that good seed results in good yields. Even simpler methods of selection of good, sound, clean well-saturated ear-head of one pure type either in the field or on the threshing floor brings about a distinct increase in yield as can be very easily seen from the results and experiments conducted on the Kenkon farms of the Torbay Presidency, quoted below:-

| Year | Yield per acre | |
|------------------------|----------------|-----------------|
| | Selected seed | Unselected seed |
| | lbs. | lbs. |
| <u>Alibor Farm.</u> | | |
| 1913-14 | 1704 | 1596 |
| 1914-15 | 2040 | 1723 |
| 1915-16 | 3400 | 3180 |
| 1916-17 | 1922 | 1704 |
| <u>Latnagiri Farm.</u> | | |
| 1918-19 | 2540 | 2000 |
| 1919-20 | 2610 | 2350 |
| 1920-21 | 2040 | 2540 |
| 1921-22 | 2350 | 2520 |
| <u>Admiral Farm.</u> | | |
| 1918-19 | 1130 | 1000 |
| 1919-20 | 2050 | 1620 |
| 1920-21 | 1910 | 1650 |
| 1921-22 | 2050 | 1830. |

227. If any of the above processes is not possible, then the farmer should at least select heavy seed which falls nearest the ear while threshing seed, because it is the heaviest of the lot.

228. Separation of heavy seed by the salt water method as practiced in Japan, also helps in improving the grade of

the seed to be used. This method consists in dipping seed in a solution of salt in the proportion of two parts of water to one of common salt, for five minutes and using the portion which sinks to the bottom of the solution. The seed thus treated should then be washed with sweet water and dried in the shade.

229. Introduction of heavier yielding varieties:- Good results have been obtained on the several rice farms of British India by the comparative trials of various rice varieties and there are sufficient grounds to believe that the same will be the case in Coa.

230. Plant Breeding Methods:- Tanjore, Madras and Bombay Departments of Agriculture have succeeded in producing out pure line strains of rice giving substantial increase in yield amounting to 20 to 30 percent or more by scientific plant-breeding methods. This is therefore a sure way of improving the yield similarly in Coa. Appointment of a Plant Breeding expert should therefore form an immediate step in the direction of improving the agriculture of community lands.

5. By more efficient methods of threshing and cleaning.

231. In the sandy-soil region it is very difficult to secure hard ground for preparing the threshing yard. Therefore threshing of rice is partly done under feet of men and partly under feet of cattle. Baskoo mat is spread on the land and on it the rice in straw is trodden under feet in such a way that most of the seed is separated from the straw. This work is done by special labourers paid at 10 to 12 annas per day, plus drink. The threshing work is completed by spreading the straw a second time under the feet of cattle.

In such regions the machine thresher has been shown to be very much labour saving.

Similarly the cleaning operation can be expeditiously done by the help of the winnower.

Both these machines would be of special advantage for the Kharif harvest as these operations in the crop are seriously handicapped owing to rainy weather.

3. Protection of crops from wild animals and birds.

282. The amount of damage done to rice crops in the hilly parts of Goa every year by wild animals, stray cattle, domesticated pigs, birds and insects is so great that in many villages the field can be saved from total destruction only by employing watchmen and putting fences. The guarding of the crops at night is very troublesome. When the thorns or bamboo branches required for fences or stakes are available the fencing can be made fairly effective in protecting the crop.

283. Wild animals:- The need of adopting remedial measures against wild animals is most urgent. Wild pigs which frequent the jungle and large waste areas are responsible for most of the damage done. Their ravages can be checked to a certain extent by organising pig killing expeditions by shooting, hunting and poisoning etc. But it will not save the crops entirely except by fencing the fields by patent pig proof woven wire fences. In the annual report of the Bombay Agricultural Department for the year 1919-20 the cost per acre for these fences for various sizes of blocks, in the Kanara district has been quoted as follows.

| Size of Block Acres | Cost per acre Rs. |
|------------------------|----------------------|
| 1/4 | 400 |
| 1 | 250 |
| 4 | 140 |
| 16 | 70 |
| 64 | 35 |
| 100 | 25 |

The larger the area in one block, the cheaper is the cost per acre. In order to derive the largest benefit, therefore, from this method of protection the fencing cost

be done on cooperative basis, and for large blocks.

224. The present system of 'Jorians' could be improved so as to make the penalties more deterrent.

225. Insect Fauna.— There are several pests from which rice suffers, but none of them are very serious excepting the rice stem borer and the swarming caterpillars. Grass borers eating leaves are occasionally seen but danger from them is comparatively insignificant for the present. It was once a very serious pest in the Belgaum and Karwar districts.

226. Very often the sterility of rice ears is reported here and there in this territory. The people attribute this occurrence to a strong wind blowing over the crop at a particular time either in the evening or at night. But the sterility is due in a greater part to the insect called rice stem borer. It is a larva of a moth, Schizochia lignivora. The caterpillar attacks at some point of the stem and it begins to girdle above the point of injury and the flower head remains straight, empty and white instead of bending with the weight of grain. Such ear-heads contain no grain, but only chaff. The department of agriculture, Bombay, have issued a bulletin (No. 69 of 1915) on the Rice Stem Borer in the Konkani, which gives remedial measures against the pest.

227. Another insect pest which has been found to do considerable damage in the Goa territory in the rice-growing caterpillar (Spodoptera mauritia). It did a considerable amount of damage to the standing rice crops especially in the Kharif season of 1921 and also slightly to the Mandana crop in the same year in the Velhas Conquistas. Various remedial measures are suggested to control the pest, such as (1) digging trenches round the affected area to prevent them from spreading to the unaffected portion, (2) burning small bundles of green grass round the area for entry traps,

shaking and destroying the caterpillars, (2) kerosinizing the water in the rice field and dislodging the caterpillar from the rice crop by drawing a rope over it and (3) cleaning the lands to expose the sun. From small areas specimens could also be collected. But all the above suggested remedial measures must be adopted by all cooperatively and simultaneously and then only there will be some relief.

238. Insect pests and diseases is a separate subject by itself and only the most important ones have been dealt with in short above, as interesting articles on the principal insect pests of rice have appeared at some length from time to time in the Goa Agricultural Department bulletins.

3. Extension
of the period
of auction of
the Community
land.

239. According to *Kavya* Leicla's Cultural Influence about a third of the rice land of Goa is occupied by the village communities. These lands consist of large blocks. They cannot be subdivided, fragmented, mortgaged or sold. There are great possibilities of increasing the output of paddy in such lands by better cultivation and better manuring. Only the present system of putting them to auction every third year has to be changed. If the lands are given out on long leases to tenants, then only they will have some stimulus to use their skill, energy, and money towards their improvement. Under the present system, the tenant always tries to get out of the land as much as possible within the short period of the lease without any adequate return to the land in the form of manure. He leaves the land less fertile than when he took it up. By this faulty method of leasing land for short periods, the community lands are gradually exhausting instead of increasing their capacity to produce more.

240. José Maria de Sá, in his book on rice cultivation in Goa, published during the year 1909, says on page 55, "In British India, improvement of land is not possible, because the land is subdivided into small parcels. In Goa large tracts of rice land belong to communities and as they are not subdivided into small holdings, their improvement is feasible."

Chapter III.

Improvement in Other Crops than Rice.

Machini.

241. Stimulation of tillering in certain parts of British India, when the machini crop is about a month old, a heavy harrow is drawn over the crop, to bend over and to make a slight injury to the crop. After this operation, the seedlings send out several tillers from their sides, each ~~of which~~ producing a separate head of grain. A similar operation could be performed here by working Ganta over the standing crop and thus encouraging tillering.

242. Rotations and Fixtures.- It would be better if a soil renovating crop like groundnut takes the place of Urad in the third year of rotation. Groundnut is the best rotation crop after machini. By its cultivation, the soil will be improved in texture and quality. Similarly Castor could be introduced as a subsidiary crop both on CUMETI and ordinary soils.

243. Manuring.- At the sub-station Pandhan (Kolaba district) experiments have been carried out with san (Crotalaria juncea) green manuring for the last seven years in manuring machini. Beneficial results have been obtained, showing every year an increase varying from 50 to 75 percent which is equivalent to 200 or 300 lbs. of grain per acre.

San green manuring can be adopted in those areas where transplanted rice is in vogue or in places, where sowing of machini is delayed till the middle of July. The detailed process of green manuring has been fully described in leaflet No. 2 of 1923 Department of Agriculture, Bombay.

244. Threshing.- Where the quantity to be threshed is sufficiently large the stone roller method could be adopted for threshing machini, as this roller method is getting popular in the Mysore State. In this system the ears of grain are arranged in the threshing yard in a circular form, the length of ears varying from 2" to 12". The roller

which is worked by a pair of bullocks, is drawn round and round over the ears, which are often raked over by means of a fork. A crop from 5 to 10 acres could be threshed in a day. The method is most economical than human and cattle threshing. ~~(Illustration No. 33)~~

Sugarcane

245. Varieties.- In the Kanara district red Mauritius has been rapidly replacing the local Basahi through the efforts of the Agricultural Department there. Several other varieties are on trial on the Kuvata farm and the Patnadi farm. At both the places Red Sorgho, Kanjav, striped Mauritius are found to be superior to the local varieties. Striped Mauritius is particularly noted for early ripening in 10½ months.

During January 1921 some foreign varieties (Red Sorgho, Striped Mauritius, Javanisiri) and Kanjav) were obtained from the Kanjri farm and are being grown at Mulay on the Faroda canal under the supervision of the Administrator of Assolna.

It seems that Red Mauritius and some of the other varieties will be found useful for introduction in Coa.

246. Subordinate Crops.- During the first three months the growth of the crop is comparatively less and in this period ^{chitki-mitli} guanni, bhendi, cucurbits, maize etc. should be taken as mixed crops. At Natgolis chilies, brinjals and maize are the usual mixtures. Shevari (Sesbania acyrtical) grows well in Coa. One or two lines of this, if grown round the cane fields makes very good live stakes for fencing and also supply some fodder for cattle. A sprinkling of casters will surely ensure oil for lubrication of sugar-mill rolls.

247. Irrigation.- Generally sugarcane does not receive any irrigation after the closure of the rains; but waterings given during this period particularly to a crop planted late would always be of advantage.

247. Recovery in the cost of Preparation, after treatment of the crop and number of sets planted per acre. - Generally plots of cane grown by individuals are small, but if the area be fairly large, considerable amount of saving could be effected by replacing the present manual labour by bullock labour. The cost of preparation could be reduced to nearly half of what is incurred by the cultivator if the land be ploughed by an improved plough ^(like "Sabul") and the opening of trenches also done by the same plough.

248. If the cane sets are planted in straight long furrows, four to five feet apart, instead of two feet as at present in Goa, a large percentage of hand labour could be substituted by a quick and cheap bullock plough for weeding, interculturing and earthing up.

Towards Natalim about 12000 to 15000 sets of cane are planted per acre. This number could be reduced to half by the method of side planting. This reduction in the number of sets has been found by experiments to give an equal outturn and an equal number of canes per acre, on account of better aeration, spacing and less crowding of side shoots during their growth.

250. Fertilizing. - The sugarcane crop requires an ample supply of manure and it responds to the same. The most important plant food required by cane is nitrogen which is not present in the soil in sufficient quantities for the full development of this heavy crop. To preserve proper texture and fertility of the soil, the use of well-rotten farm yard manure, green manures, with a top dressing of fish, oil cakes and Sulphate of ammonia have been found beneficial. The top-dressing of sugarcane with the above concentrates has produced very good results in several parts of British India including the Patnagarh and Kanta farms of the Bombay Presidency, the climatic and soil conditions of which are almost identical with those of Goa. A dose of about 2 to 3 cwt. of sulphate of ammonia is enough



Illustration No. 13

Necessaries required in jaggery making. (1) Shibe for removing scum.
 (2) Wooden spatula (4) scraping hook (5) Scum strainer (6) Wooden hoe
 (7) shovel (8) Gul moulds (9) Gul mould with false bottom.

By courtesy of the Bombay Agricultural Department.

"Balodyan Press, Poona."

for an acre. About a third of the total dose should be applied when the crop is one month old and the rest applied with cake and other manures at the time of the earthing up of the cane.

351. Fitness of Cane. - The use of Brix Saccharometer for determining the ripeness in cane is becoming popular in the cane growing areas of the Deccan. Instructions for using this instrument have been fully given in the Leaflet No. 4 of 1914, issued by the Bombay Agricultural Department. The degrees at which the cane ripens in Goa lie between 16 to 20 degrees Brix.

352. The wooden mills extract about 55 percent of juice, the Poona three roller Iron mill expresses 64 to 66 percent, while the power mills extract from 72 to 75 percent of juice.

353. In the Ratnagiri and Kanara districts, the Bombay Agricultural Department is recommending the improved sugarcane mill, Chatanooga No. 13 (Sold by Messrs. Marshall Sons & Co., Bombay) for extracting juice from cane, Poona shallow iron pans, other improved accessories and Poona furnace for boiling juice into mol. (Vide illustrations Nos. 13 and 14). Full particulars regarding Poona furnace are published in Leaflet No. 16 of 1909 of the Bombay Department of Agriculture.

Similarly sugarcane mills under the name "Poona type Kirloskar Cane Mill No. 5 and Kirloskar "kisan" are manufactured by Kirloskar Brothers, Limited, District Satara. (Vide Fig. No. 8 of the Illustration No. 14). There is more demand for Poona type mills from the Goa territory

354. For small sugarcane farms of 10 to 20 acres, power crusher, Chatanooga, No. 44 is recommended. The multiple furnace which requires large quantities of juice at a time is suitable where power crushers are used. Full particulars about these furnaces are published in Leaflet No. 9 of 1914 of the Department of Agriculture, Bombay.

255. Onions and Chillies.— Garden crops of various kinds, such as, onions, chillies, Bananas, sweet potatoes, leucos, cucurbits &c are extensively grown in small patches by the cultivators as a second crop after the harvest of the main rice crop. The Bananas is a speciality in the Poira villages. The cultivation, manuring &c are far superior and there is very little to teach in its treatment.

256. Onions and chillies are the two crops which are grown to a more or less extent by almost all farmers in the territory, those grown in the villages of Poira, Aliona, Dushar Jua and Jua being on a commercial scale.

257. The cultivation, manuring and irrigation are very carefully done. The only defects found are very close planting and consequent crowding of seedlings in the rows as well as between seedlings in the line. A 4" to 6" inch distance between two plants in the row and about a foot between two rows in the case of onions and 1 to 1 1/2 feet between seedlings both ways in the case of chillies, would give a better crop. By increasing the space in the case of chillies, there would be better branching and better facilities for intercultivation.

258. The usual manures applied are fish, ashes and sparingly rice dune. The manual experiments conducted in the Konkan tract of British India show that a top-dressing with 2 cwt. of Nitrate of Soda has given very beneficial effects on onions; sulphate of Potash when applied at the rate of 1 cwt. per acre is beneficial particularly in respect of improving the keeping quality of the bulbs.

259. In the case of chillies, which belongs to the potash-loving order of plants, sulphate of potash at the rate of 1 cwt. per acre in addition to local manuring increases the yield very markedly.

260. This crop in general is very much subject to a disease locally known as "khetto" and in Sanskrit as "Murda". In

this disease the leaves get reduced in size, crumpled and curled and the result is that the fruit bearing quality of the plant is considerably reduced. This disease has been found by the Bombay Agricultural Department to be caused by a mite which can be easily and completely checked by spraying the plants with a mixture of sulphur and lime. Full instructions for making concentrated lime sulphur wash are given in appendix No. 3.

260. Estimote. - As in the adjoining district of Kanara, the betelnut gardens of Goa also suffer from a disease, which causes the fall of a large number of fruits. This disease is called "Morla Sadra" in Goa, and "Kolerosa" in British India. On enquiry, I find that a large number of unripe fruits fall off from the bunches during the months of June and July every year.

261. Experiments conducted in the Kanara district of British India show that this disease could be controlled conveniently and cheaply by spraying the bunches with Bordeaux mixture. The spraying is to be done just before the rains i. e. end of May or early in June.

262. The Bordeaux mixture is made up of Borax Sulphate, Lime (unslaked), resin and Soda. The cost for spraying 500 trees works out at Rs. 6 to 7 (cost of mixture Rs. 2 to 3 plus wages for spraying). The sprayer costs about Rs. 25 and could be purchased on a cooperative basis.

263. Full details regarding the treatment of this disease are given in Leaflet No. 8 of 1914, Department of Agriculture, Bombay.

264. Cocoanut. This is a highly valuable crop of the ⁴¹territory and stands second to rice. The tree grows with great vigour all along the sea coast and forms the chief protect of the sandy plains, banks of tidal rivers and creeks. It is also extensively cultivated on the lower slopes of hills.

Further away towards the inter-space between the rows.

In Goa, the manure is applied immediately in the basin surrounding the trunk.

In several places in Ceylon it is found that the manure is applied in a $\frac{1}{2}$ ft trench dug up at a radius of 1' to 5' feet from the trunk.

The following manure mixture per tree has given fairly good results in the plantation belonging to Mr. Valient Nank of Latalia.. S.I.P.

One heap load of [^]gan green plants.

3 lbs. of bone meal

3 lbs. of oil cake

2 lbs. of fish

4 lbs. of salt

1 large basket of ashes.

1 large basket of well rotted farmyard manure.

San plants should be thrown in a trench and then all other manures mixed well and applied. This should be done at the end of August or early in September

262. Mr. Kelway Parker, Agricultural Chemist to the Ceylon Government, who is an authority on manuring of coconuts writes to me on 27th January 1923 and recommends the following mixture for trial in Goa.

| | Lbs. | |
|-----------------|-------------|-------------------------------|
| Fish manure | 300 |) containing |
| Fish guano | 150 | |
| Groundnut cake | 300 |) Nitrogen = 14.5 lbs |
| Bone meal | 150 | |
| Supersphosphate | 100 |) Phosphoric acid = 60.0 lbs. |
| Kainit | 300 | |
| | <u>1000</u> | Total = 25.0 lbs. |

This manure should be forked in round the trees at the rate of 10 lbs per tree in a ring 4' to 7' feet in diameter mulched with bushes, buried leaves or any other organic matter available.

365. The Penaulic villages near Lareno is noted for coconut seedlings for over hundreds of years. It supplies seedlings to the whole of Coa, as well as to the neighbouring Kenian tract.

366. In the majority of plantations the trees are laid out very closely and irregularly. The best distance is 25 to 30 feet each way. If this distance is given, then the leaves of a full grown tree, which are about 12 feet long, will not interfere with those of the neighbouring tree. Some proprietors, now-a-days with scientific knowledge have begun to realize that sufficient space, light and air are required for the better development of the tree. Some have begun to cut down trees to bring in light and give more space. This is satisfactory.

367. Various kinds of substances are used for ensuring and improvement of the texture of the soil in the coconut basins. They are as follows:- Fresh fish, shell fish, ashes, salt, loessings of trees, river mud, field earth, tank mud, burnt earth, lime, shells, sand and red laterite earth from hills. The following statement shows the results of analyses of the most important mineral substances:-

| | Mixture of shells and sand : | River mud* | Burnt earth | Natural earth |
|-----------------|------------------------------------|---------------|----------------|------------------|
| | Percent | Percent | Percent | Percent |
| Lime (CaO) | 48.38 | 0.67 | 0.67 | 0.39 |
| Phosphoric acid | 0.38 | 0.45 | 0.71 | 0.07 |
| Nitrogen | - | 0.21 | 0.09 | 0.07 |

* This sample contains organic matter.

368. It is advisable to use nitrogenous manures before the plant begins to bear and afterwards more Phosphates and potash $\frac{1}{2}$ manures should be applied.

Large trees do not draw their food directly from the surface soil immediately round their bases, but from that

Further away towards the interspace between the rows.

In Goa, the manure is applied immediately in the basin surrounding the trunk.

In several places in Ceylon it is found that the manure is applied in a γ shaped trench dug up at a radius of 2' to 5' feet from the trunk.

The following manure mixture per tree has given fairly good results in the plantation belonging to Mr. Vaidant Nair of Latholli., C.I.T. .

- One heap load of \hat{g} green plants.
- 3 lbs. of bone meal
- 3 lbs. of oil cake
- 3 lbs. of fish
- 4 lbs. of salt
- 1 large basket of ashes.
- 1 large basket of well rotted manure.

San plants should be thrown in a trench and then all other manures mixed well and applied. This should be done at the end of August or early in September.

See. Mr. Kelway Baxter, Agricultural Chemist to the Ceylon Government, who is an authority on manuring of crops writes to us on 27th January 1923 and recommends the following mixture for trial in Goa.

| | | |
|----------------|-----------|---|
| | Lbs. | |
| Fish manure | 200 | } Containing Nitrogen = 24.5 lbs Phosphoric acid = 60.5 lbs. Total = 85.0 lbs. |
| Fish guano | 150 | |
| Groundnut cake | 200 | |
| Bone meal | 150 | |
| Superphosphate | 100 | |
| Kainit | 200 | |
| | 1000 lbs. | |

This manure should be forked in round the trees at the rate of 16 lbs per tree in a ring 4' to 7' feet wide mulched with husks, burnt leaves or any other organic matter available.

Illustration No. 15



(A) *jowar and cotton.*



(B) *jowar, cotton and castors.*

"Balodyan Press, Poona."

270. Tachrodia curvata or any other green mite should be grown between the palms at least 6 feet apart and cut at 18" inches before flowering and the material piled round the palms when the mite is applied."

271. In the whole, the cultivation of coconut does not seem to be satisfactorily done in Goa; for the trees are mostly found to be poor bearers and are left uncared for to the ravages of beetles and other insects. But rot is not uncommon and no pains seem to be taken in removing trees totally damaged or in treating those partially affected.

272. Measures against the destruction of coconuts by Rats and palm beetles are fully detailed in leaflets Nos. 9 of 1915 and 2 of 1917 of the Dept. of Agriculture, Bombay.

circulation
of the
leaflets
is
very
large.

273. From the experiments carried out in the native Korine Konkan districts as well as in the sea territory itself, it has been found that the well drained rich land conditions of Goa are suitable for growing groundnut,

pepper, castor, cotton (Vide illustrations Nos. 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000)

Sisal hemp, tarloca, castor, groundnut, and sugarcane. ¹⁵ During the year 1921 about 875 ^{of groundnut seeds} were planted ^{by the cultivators}. A roller crop could also be grown in rice fields in the fair season under irrigation. The methods of cultivation and the yields that might be expected of these crops except castors, sisal hemp and tarloca are published in Leaflet Nos. 3 of 1910-11, 6 of 1912, 11 of 1913, 12 of 1914, 12 of 1915, 12 of 1916, 12 of 1917, 12 of 1918, 12 of 1919, 12 of 1920, 12 of 1921, 12 of 1922, 12 of 1923, 12 of 1924, 12 of 1925, 12 of 1926, 12 of 1927, 12 of 1928, 12 of 1929, 12 of 1930, 12 of 1931, 12 of 1932, 12 of 1933, 12 of 1934, 12 of 1935, 12 of 1936, 12 of 1937, 12 of 1938, 12 of 1939, 12 of 1940, 12 of 1941, 12 of 1942, 12 of 1943, 12 of 1944, 12 of 1945, 12 of 1946, 12 of 1947, 12 of 1948, 12 of 1949, 12 of 1950, 12 of 1951, 12 of 1952, 12 of 1953, 12 of 1954, 12 of 1955, 12 of 1956, 12 of 1957, 12 of 1958, 12 of 1959, 12 of 1960, 12 of 1961, 12 of 1962, 12 of 1963, 12 of 1964, 12 of 1965, 12 of 1966, 12 of 1967, 12 of 1968, 12 of 1969, 12 of 1970, 12 of 1971, 12 of 1972, 12 of 1973, 12 of 1974, 12 of 1975, 12 of 1976, 12 of 1977, 12 of 1978, 12 of 1979, 12 of 1980, 12 of 1981, 12 of 1982, 12 of 1983, 12 of 1984, 12 of 1985, 12 of 1986, 12 of 1987, 12 of 1988, 12 of 1989, 12 of 1990, 12 of 1991, 12 of 1992, 12 of 1993, 12 of 1994, 12 of 1995, 12 of 1996, 12 of 1997, 12 of 1998, 12 of 1999, 12 of 2000.

275. Castors can be planted as a mixed crop along with cashew by sowing seeds 6 feet apart each way.

276. Cotton is to be sown early in June so that the plants would grow up sufficiently before the heavy down-ours commence. Varahi, Chaudharia and Sadar No. 1 are the kinds which promise to be suitable. The planting is to be done 2 1/2 to 3 feet apart each way. These varieties begin to yield from October and are finished by the end of December.

277. Various would do very well in coconut plantations as well as on rich lands. Cuttings of stems are to be planted at a distance of not less than 6 feet each way by

the beginning of the monsoon and the crop is ready in 7 to 8 months. The roots furnish nutritious food.

276. From the experiments conducted on the Government Farm, in the North Kanara district, it seems that tobacco could also be successfully grown on the well drained soils of Goa. Full details regarding its cultivation, method of drying and curing &c appear in the Leaflet No. 6 of 1931, Department of Agriculture, Bombay.

Chapter XX.

Improvement of the Economic Conditions.

Land

277. Some sort of legislation which will create some permanent interest of the cultivating tenants in the land they cultivate and will keep under control any increase in rent by the land-lords would be desirable and might be considered.

278. Co-operative leasing and cultivation of land might perhaps prove of great use in promoting direct dealing by the communities with the cultivators resulting into increased income both to the communities and the cultivators.

Education.

279. ~~General education is perhaps the best~~ *General education is perhaps the best* powerful means to do this. This education can be imparted *at school to the young generation and* through literacy, *through preaching and through public demonstrations to the public in general.*

280. It has been observed that the whole time of the cultivator is not taken up by the field work. It is possible to turn his spare time to advantage by his taking to certain small cottage industries side by side with agriculture.

281. Amongst the several cottage industries which require less initial expenditure, I may say that hand-loom weaving comes pre-eminently the first and the next suitable. Hand-made cloth is in great demand on this side and it may be interesting to note that at Bangalore almost every Christian family is in some way or the other engaged in the hand-loom industry. Next to this will be poultry-breeding though it involves some risk, especially when there is an outbreak of some zoonotic poultry disease.

282. Along with the milk growing industry by-products from the coconut trees - viz.: useful articles as brooms, brushes, coir, ropes, mattresses, buttons etc. can be profitably manufactured without much cost for machinery so by the cultivator. This manufacture of articles of every day use can be undertaken by the cultivator either during his leisure hours or during the slack ~~///~~ season when he is forced to leave his home in search of employment for his livelihood.

Part 1.

283. The best means for supplying cheap capital, for promoting credit, for inculcating thrift and securing large profits is cooperation.

Chapter XXI.

Measures for Bringing about Improvements.

284. Before making recommendations about the general outlines of measures that should be adopted for the introduction of the improvements dealt with so far, it will not be out of place if some of the special difficulties and limitations peculiar to Goa with which the work of agricultural improvement is beset, are indicated.

285. The man at the plough is generally poor and lives a hard to mouth existence. His resources and credit are meagre. He neither owns the land he cultivates nor has he any permanent interest in it, being only a tenant-at-will and the ownership resting with the communities whose interest in the land ceases with the realization of as much rent as the law of supply and demand can bring in. He has no ambition and no luxurious habits.

286. From the writer's short experience in this territory it seems to him that there is very little sympathy on the part of the general public towards the work of agricultural improvement if any undertaken by ^{the} Government. The public as well as the members of the village communities instead of giving possible help to any worker in the line put forth all sorts of difficulties in ^{his} the way. Any suggestions of improvements are looked down upon with suspicion. Some people believe that such a movement aims at enhancement in the existing rates of taxation, while others suppose that what is done on the Experimental Farms is beyond the means of actual cultivators.

287. Under these circumstances, it can be seen how it is not an easy task to carry to the very door of the tenant farmer, knowledge about agricultural improvements. The work would, however, be much facilitated if the right-holders or owners of the village communities can be persuaded to

look into the matter of improvements and insist on the State to help the tenants to carry out improvements.

288. Notwithstanding the difficulties and limitations referred to above, the general outlines of measures which are to be recommended for finding out and introducing improvements are:-

- (1) Establishment of Experimental Farms.
- (2) Organization for the introduction of improvements consisting of
 - (a) Demonstration farms and plots.
 - (b) Prizes.
 - (c) Itinerant advice
 - (d) Arrangement for supply of improved seed, implements, manures &c until they become market commodities.
 - (e) Publications.
- (3) Provision for medical relief in epidemics and other diseases of cattle.
- (4) Organization for the spread of the cooperative movement.
- (5) Legislative Measures.
- (6) Education.

Experimental Farms.

289. There should be two experimental farms in the territory - one representing the coastal or the sandy soil tract - the other representing the laterite, clayey or hilly tract. The present farm at Assolna will be suitable for the sandy, coastal tract, while for the inland and hilly regions Borin in Ponia is suggested.

290. The object of these farms should be to try and test new methods, crops, practices &c which would be the most possible for use from researches carried out elsewhere. Research work of an elaborate original nature need not be the aim of these farms.

291. To these experimental farms might be attached areas for multiplying seeds of good and improved varieties of crops for distribution to cultivators.

Organization for the Introduction of Improvements.

Organization
plots in cul-
tivators'
fields.

292. Whatever successful results are obtained on the Experimental Farms, they should be brought to the notice of the cultivator by this method. These demonstration plots might be as many as possible each village community having at least one.

293. Each village school might also have a small plot of land attached to it for testing new plants, which are not familiar to the local people. The agriculturists will then have an opportunity of personally seeing the growth of such plants which may, if found suitable, gradually enter into general cultivation.

Prize.

294. In all walks of life competition plays an important part and anything that serves to set up competition must necessarily be welcome, therefore it is to be suggested that prizes may be awarded as a stimulus to the best endeavours made in effecting the several improvements.

Propagandist
system.

295. In order to spread knowledge of the improvements far and wide amongst cultivators, it is necessary to provide for a band of trained practical men who should preach and actually show by actual practical work all the improvements possible from village to village. For this purpose each taluka should have at least one trained man of the type of Kargars in the Bombay Agricultural Department. These men should carry on their work in the same manner as religious propagandists do theirs.

Provision
of the supply
of improved
implements
and seeds.

296. Each village community should have depots for supplying to the tenants a stock of improved implements, new manures, selected seeds of important staple crops, seeds

of exotic and new crops to be recommended until they become market commodities. The costly implements might also be kept for being lent out on hire to cultivators.

Publications.

297. The publication and distribution of agricultural information is a very useful medium for the spread of agricultural knowledge. The recommendations of improvements that are of practical utility should be published in the Vernacular languages and distributed broadcast amongst literate agriculturists of the villages through the leader of the village who should also be made to read them once a month to the gatherings of the illiterate villagers.

Provision for medical relief in epidemics and
Diseases of Cattle.

298. Although there is a Veterinary section under the Goa Department of Agriculture, no adequate arrangement to afford medical relief which would reach the villages seems to have been made perhaps for want of funds or absence of interest on the part of the people. There is a very good field for controlling epidemic diseases by inoculations by a trained veterinarian touring in the affected parts. If he carries with him an emergency stock of medicines at such times, he would also be able to treat simple ailments of cattle side by side.

Organization for Cooperative Movement.

299. In order to supply cheap capital and to promote credit, thrift and the feeling of self and mutual help as well as to secure an even distribution of wealth and higher profits to the producers, steps should be taken to develop cooperative societies. There are various forms of cooperation which can be stimulated in Goa and cooperative leasing and cultivation of land might perhaps prove of great use in promoting direct dealing by the communities with the cultivators resulting in increased incomes both to the communities as well as the cultivators.

Legislative Measures.

200. Tenancy legislation:- Some sort of legislation which would create some permanent interest of the cultivating tenants in the land and control undue increases in rent by the land-lords might be considered.

Education.

201. Education is a very great help for introducing improved ideas and agriculture is no exception to it. This education might be imparted through the school, through preaching or demonstration.

It would be a great advantage if along with primary education, some sort of Agricultural instruction be imparted. For this purpose nature study and agricultural instruction should be introduced in the standards of primary schools to which school gardens should be attached; lessons on agricultural subjects should be embodied in the ordinary standard series. The students may be shown the agricultural practices and growing of crops in the villages. The teacher should often take the pupils round about the villages and practically explain to them, the lessons he taught in the school.

Directing, Controlling and Executive Machinery recommended.

202. There is already a Director of Agriculture, an Agricultural Expert and a Veterinary Officer at present, which is a sufficient controlling and directing establishment.

203. In order to carry out the actual investigational and propaganda work, throughout the territory, the following subordinate establishment would be necessary:-

| | |
|--|-------|
| (1) Two Agricultural Graduates for investigational work @ Rs. 100 to 200 each | 4800 |
| (a) | |
| (2) One agricultural graduate for propaganda work @ Rs. 100 to 150 | 2400 |
| (b) three khudais (trained agriculturists) for demonstration work @ Rs. 80 to 60 each to assist the propaganda officer | 1800 |
| (3) One travelling Veterinary Assistant @ Rs. 100 to 200. | 2400 |
| | <hr/> |
| | 11200 |

204. The above technical establishment would also require the necessary clerical and menial establishment and provision of Travelling allowances and a recurring contingent expenditure, all amounting to about Rs. 15000 out of which the Experimental farms would require about Rs. 5000 to Rs. 10,000

15000

Thus the whole organization proposed would cost Rs. 50000 annually, including the superior controlling and directing establishment.

Board of Agriculture.

205. For determining and controlling the general policy of the agricultural improvement, there should be constituted a Board of Agriculture.

The Board should consist of

The Director of Agriculture - President - ex-officio and four members nominated by the Government

(a) Two should be selected from the Presidents of the Janta of the Community, (b) one out of the elected members of the Legislative Council and (c) one Prastar taking interest in agriculture.

These members should retire triennially, but be eligible for re-appointment. The Board should meet once in three months, three members forming a quorum. The Agricultural Expert should be the Secretary of the Board.

Chapter VIII.

Summary of Conclusions, Suggestions and Recommendations.

206. From the information detailed so far it may be summarized that it is possible to increase the yield of rice, the principal crop of the community lands, by about 50 to 75 percent, by employing better methods of sowing, by using better seed, by improving irrigation facilities etc

Paragraphs.

Soils.

- (1) Improvement of sandy soils by the addition of organic matter and earth from fields, hill sides and mud from rivers. 138
- (2) Reduction of heaviness of clay soils by the addition of tank yard manure, green manure, leaves and sand. 138
- (3) Improvement of gravelly or stony soils to increase fertility and hold more water by the addition of green manure, river mud, clay, lime and salt. 139
- (4) Improvement of Machini lands in the open slopes of hills by terracing and level-line and thus stopping erosion. 140

Water Supply.

- (5) Maintenance of community tanks under proper repair in order to avoid the great loss of water by seepage and percolation. 171
- (6) Maintenance of proper control over the wasteful use of tank water by the tenants and the consequential increase in the area under Vansana paddy. 182-184
- (7) Making some permanent arrangement for closure of the outlets of the tanks during the Vansana season to avoid annual recurring expenditure. 185
- (8) Making similar arrangements to dam up the streams in the Novas Conquistas by construction of masonry pillars and close the stream temporarily by inserting planks or iron shutters. 185.

Water Supply (continued)

- (9) Provision of contrivance for equitable distribution of water to the holders of land situated at high and low levels. 136
- (10) Construction of more distributaries and water courses for an even and quick distribution of water through the fields 136
- (11) Introduction of Pulzar Water, the Roman Persian wheel and oil engine and *runns wherever possible.* 137

Implements.

- (12) Introduction of improved implements such as, Eureka and Weston rouches and Disc Harrow for rouching; Deccan Harrow, Rice land rill for rilling; American clitter drill and six-coultured karnatak rice-drill for sowing; Patani for level-line and Thresher and winnow for threshing and cleaning rice. 144-154
- (13) Opening of ^ALonets for supply and hire of costly improved implements. 144

Manures.

- (14) Better conservation of cattle-dung and preservation of μ urine. 156-159
- (15) Extension and improvement of the practice of tethering cattle in rice fields and introduction of Jaffana method. 160-161
- (16) Improvement in turning land. 163
- (17) Prising night soil and human urine into general use wherever possible. 164-165
- (18) Use of more leaf (either dry or green) and rice hulls as manure. 165
- (19) Use of oilcakes as manure on a large scale. 165-170

~~Manures (Continued)~~

- (20) The grove of Teak and Mal trees, which supply oil and cake should be extended. 171
- (21) Castors and groundnuts can be grown with advantage in certain parts of the territory and will be able to supply additional sources of oilcakes. The cultivation of these crops should be stimulated. 172
- (22) Fica, coconut and other fruit trees are very much benefited by the application of bone-meal. Every effort should be made to organize the collection and crushing of bones which are locally available. Any deficiency can be met also by its import. 174-176
- (23) Use of blood and other refuse from slaughter houses. 177
- (24) Amongst the artificial manures Sulphate of Ammonia for rice and sugarcane and Nitrate of Soda for onions have been found to be payine and are to be recommended. 178
- Cattle.
- (25) Making provision of good and sufficient food and fodder. 180-187
- (26) Improvement of cattle by directly importing suitable bulls from outside and supplying them to the villagers on premium basis. 188
- (27) Improvement of cattle by establishing cattle-breeding farms. 189
- (28) Improvement of cattle by better housing, care, management and control of diseases. 190-190

Items.

- (29) Increase in the area under rice cultivation involving about 6 percent of the total deficit. 198
- (30) Extension of irrigation facilities - construction of more tanks and reservoirs, repair of old tanks &c which will bring an increase of production by 10 to 30 percent. 199-201
- (31) More economical preparation of soil by the use of improved implements, such as *ploughs and* Eureka, *Newton* *Duncan* harrow. 202-203
- (32) Putting up of better bunds for impounding of water. 204
- (33) Extension of transplanting, causing a saving in seed upto 6250 annas and increase in yield to about 10 percent or equal to 20 thousand annas. 205
- (34) Drilling in places of sowing after the plough. 206
- (35) Encouragement for the application of green matter in the form of man, lupi and Adulsa leaves. 213-215
- (36) Encouragement for the use of rice bran and pie dune which gives an increase in outturn amounting to 15 percent at *Bandora* *Benaulim* *Benaulim* and 23 percent at *Bandora* over the ordinarily manured plot. Encouragement for the use of Horse dung wherever available. 214-215
- (37) Encouragement for the use of oilcakes which have given an increase amounting to 23 to 40 percent on the clayey soils of *Bandora*. 217

Rice (continued)

- (38) Encouragement for the use of sulphate of ammonia which has given over 30 percent increase over the ordinarily sown plot at Panora and has done well on sandy soils at Panaulic in combination with cowdung. 218-219
- (39) The bonemeal has given an increase of about 18 percent on both the soils. The rice sowing mixture of the Union Agency has also given promising results. 219-220
- (40) Improvement in the methods of preparing seed bed according to local method and encouragement in introducing substitutes like cakes, sulphate of ammonia, for raising rice seedlings wherever the deficiency of burning materials is experienced. 223
- (41) Measures for ordinary selection of seed, salt water method, selection of higher yielding varieties and halving of seed rate. 224-225
- (42) Appointment of Plant Breeding Expert for finding out pure strains of rice by scientific methods, which may give an increase in yield amounting to about 20 to 30 percent. 230
- (43) Introduction of Thresher and winnower for more efficient methods of threshing and cleaning. 231
- (44) Protection of crops from wild animals by organizing pig-killing campaign and by encouraging the introduction of wire-proof woven wire fences and from stray cattle by improving the present system of "Corias". 233-234

| | Paragraphs |
|--|------------|
| <u>Fig. (Continued)</u> | |
| (45) Mention of measures for protecting crops from insect pests and diseases. | 235-237 |
| (46) Extension of the period of auction of the community lands. | 239-240 |
| <u>Improvement in other crops than Fig. Machini</u> | |
| (47) Stimulation of tillering by working <u>ganis</u> over the standing crop. | 241 |
| (48) Green manuring with <u>gan</u> in places where transplanted and late sowing are in vogue. | 242 |
| (49) Introduction of stone roller in threshing where the quantity of Machini to be handled is sufficiently large. | 244 |
| <u>Sugarcane.</u> | |
| (50) Introduction of early and more prolific varieties. | 245 |
| (51) Encouragement for growing subordinate crops, <u>ghani</u> and castors as fence plants. | 246 |
| (52) Irrigation of sugarcane after the cessation of rains. | 247 |
| (53) Introduction of Babul plough for ploughing and earthing up and one bullock hoe for interculture. | 248 |
| (54) Reduction in the number of sets planted by adopting wider method of planting. | 249 |
| (55) Extension of green manures and introduction of oilcakes and sulphate of ammonia in the manuring of sugarcane. | 250 |
| (56) Testing the ripeness of cane by the use of Frix saccharometer. | 251 |
| (57) Introduction of improved sugarcane mills, boiling pans and pul boiling furnaces. | 252-254 |

Paragraphs.

Cucumbers and Chillies.

(58) Giving more space in the case of chillies to encourage branching and to facilitate intercultivation. 257

(59) For increasing the onion crop with 2 cwt. of Nitrate of Soda per acre to increase production and application of 1 cwt. of Sulphate of Potash to improve the keeping quality of the bulbs. 258

(60) For dressing the chillies with 1 cwt. of Sulphate of Potash per acre to increase production. 259

(61) Control of "Kuttib" or "Toria" in chillies by spraying the plants with lime sulphur wash. 260

Walnut nut.

(62) Adoption of remedial measures to control "Toria zaina" by spraying Bordeaux mixture on the bunches of nuts during May and June. 261-262

W. Citrus.

(63) Encouragement in giving best distances between trees in new plantations and pruning to cut down some of the trees in old plantations to admit more air and light to improve the fruit bearing capacity. 266

(64) Encouragement for rendering the trees 2 to 3 feet away from the trunk roads in the orchards and gardens. 267

(65) Trial of orange and grape varieties by Mr. Keshav Dattar - Agricultural Officer, Kalyan Government. 268-270

Se-canute (continued)

- (66) Control of insect pests and diseases by clean cultivation, avoiding the heaping of rubbish, rotten and affected ones in the plantation. 271
- Introduction of more profitable new crops
- (67) Groundnuts, Pomegranate, castors, cotton sisal hemp, Tapioca, Tobacco, Guinea grass and Shewri on high lands, and Lucerne as a second crop after rice. 272-276
- Improvement of the Economic Conditions.
- (68) Legislation to create interest of the tenants in the land and to control undue increases in rent by landlords. 277
- (69) Encourage cooperative lending to promote direct dealing by the communities with the cultivators. 278
- (70) Arrangement for imparting agricultural education through literacy, preaching and demonstrations. 279
- (71) Introduction of small cottage industries amongst the farmers to turn his spare time to advantage 280-282
- (72) Introduction of cooperative movement for supply of cheap capital and promote credit. 283
- Measures for bringing about Improvements
- (73) Removal of difficulties pointed out in paras 284-286 by the right holders or Gawkars of the village communities and to insist on the State to help the tenants to carry out improvements. 287

- (74) Establishment of experimental farms -
at Assolna and Forin with attached areas
for multiplication of seeds. 289-291
- (75) Organization of demonstration plots in
village community lands 292
- (76) Provision of a small plot of land for
each village school for testing new
plants. 293
- (77) Awarding of prizes to the cultivators for
adoption improvements. 294
- (78) Provision of trained men for showing
practically the possible improvements
from village to village. 295
- (79) Establishment of centres by the village
communities for supplying improved in-
struments - new manures, selected seeds
and seeds of exotics. 296
- (80) Publication of information of practical
utility in the vernacular language and
distributing leaflets amongst literate
agriculturists and also to insist on the
Director to read them to the gatherings
of the villagers, once a month. 297
- (81) Provision of medical relief in epidemics
and other diseases of cattle through a
trained veterinarian who carries a stock
of emergency medicines. 298
- (82) Organization of cooperative societies
to promote credit, thrift, feeling of
self help and to stimulate cooperative
leasing and cultivation of land. 299
- (83) Tenancy legislation to create permanent
interest of the cultivating tenants and
also to control undue increases in rent. 300

Paragraphs.

- (84) Arrangement for agricultural instruction
along with primary education in the
schools and also through teaching and
demonstration. 201
- (85) Provision of 3 additional graduates, ^{one Veterinary Assistant} A
and three kāpangs to carry on investi-
gational and prophylactic work. 202
- (86) Constitution of the Board of Agriculture
to determine and control the
general policy/ of the agricultural
improvement. 203

Annex No. 1.Nachini (Eleusine coracana)

This crop being principally a crop of the uplands and well drained situations, it is chiefly grown in the hilly tracts where it forms the staple food of the agricultural population. Most of the people who are chiefly engaged in manual labour use it as their food.

Soil.- Nachini thrives on lighter soils in seasons of good rainfall. The crop is generally grown on land which is too light and steep and cannot be easily converted into rice fields. The typical nachini land is red laterite, gravelly, stony or loamy soil. It is also grown on alluvial loams along the river banks. Good yields of this crop are obtained on rich forest soils as well as on the embankments of canals.

Varieties.- There are two principal varieties or types of nachini in Goa. One has rather a closed and compact head called uthalo or khare-uthalo, and the other is keru which bears loose, open and spread out spikes. The variety grown on alluvial soils is called uthalo-nerga. Closed heads generally contain more grain than the open ones. The variety grown on fairly level lands is an early variety which ripens in about 3 months, whilst the variety grown in Surat takes 4½ to 5 months.

Rotations and Cycles.- There is no systematic rotation, but the prevailing practices are as follows:- Nachini is the principal crop of the uplands and is always cultivated as a second crop after fallow, kulith being the first year's crop.

| | |
|-------------------------------|---------------------|
| 1st year | Kulith |
| 2nd year | Nachini |
| 3rd year | Padi or Sato |
| 4th year | Sesamum (Sang tili) |
| Then fallow for 3 to 5 years. | |

Occasionally Wanda-~~Wanda~~ is rotated with nachini. In the Surerin lands nachini is followed in the second year by Cris. Then the land is left fallow for 3 to 4 years. In ^{násona} ~~Casapa~~ chillies are followed by nachini.

It is only in the case of transplanted nachini that it is grown as a pure crop. In other cases, the component subsidiary crops grown along with it are pulses. One or two sub-crops such as Cori, culith and tor are grown by sowing a small quantity of seed with the main crop.

Tor is grown as a row or sowed crop in the Surerin cultivation of Estary, Sanquilia and Sanpaca. It is also sparingly cultivated in the ^A Jarnar taluka.

The ordinary mixture all over the territory is Cori and culith.

Cultivation.

Methods of Planting.- There are two methods, one is transplanting and the other is sowing the seed broadcast.

In the transplanting method, a nursery is generally made in close proximity to the rice land. The soil in the seed-bed is finely prepared and heavily manured with fish, cow-dung, pig-dung or goat-dung (the last specially by sheep-herds) or sometimes the seedbed is burnt with lowrines, cow-dung and grass, in the month of April or May and the seeds sown in ashes exactly in the same way as is done in the case of paddy in the Galar system. About 5 to 6 lbs. of seeds sown on 3 or 2 sathas of land will supply enough seedlings to transplant an acre. When the seedlings are three weeks or a month old they are uprooted and taken to the higher lands for being transplanted. In the meantime the main area is not ready to receive seedlings.

Preparation of soil.- When the land is thoroughly soaked with rain in the month of June, the main field is given two ploughings with the neckline of the plank harrow at intervals. By the end of June or about the middle of July,

the land is levelled, the furrows are opened 9" to 13" apart and the Machini seedlings are thrown in the furrow about a foot apart one by one. These take root and stand upright in a week or ten days. Such system of cultivation could be found in the Aharharong tract. This system is rather risky, because if heavy rains come immediately after planting the seedlings are washed away on steep lands and if the rainfall be deficient then several seedlings become withered, and die.

When the seedlings are well established, a small quantity of ash is spread broadcast in the field. In about a month after transplanting, one hand weeding is given to the crop. Then nothing is required to be done till the time of harvesting.

In certain parts of Pernem (Mandrem, Korcik, Harwal, Querik etc) and in various parts of Parikal and Saqualim where transplanting method is practised, the land is well prepared either by ploughing or hand-digging and then in the month of July, the seedlings which are first raised in the nursery are transplanted in holes, which are made into the ground by a pointed stick, about 9" to 13" apart each way. About half a fish or a small quantity of fish powder is thrown into the hole and a couple of seedlings are planted and the soil ~~pressed~~^{pressed} round them. About 300 to 400 lbs of fish manure are applied per acre.

Along the banks of Tirocol river the seedlings are planted on the alluvial soil when the water recedes in the month of August. The variety grown is Iulha-morra.

Similarly local machini seedlings are transplanted in August on the embankments of Tagana lands at Sushar Juvá, Juvá, Chiroia, Madona, Loitulia etc. Excellent yields are obtained all along these embankments.

The broadcast method is commonly adopted almost everywhere in Goa. When the paddy sowing is over the preparation

of soil for machini berries. Generally machini lands have small or large bushes growing on it. These are lopped in April, when dry, they are spread out and burnt. Jalay, Colea, Janacona etc. where the entire area is burnt with terraces of trees about 10 to 12 lbs. of machini seed is ~~now broadcast~~^{perare} in the ashes and ploughed in before the rains.

On fairly along grounds as at ^ACorcão in Fernes or at ~~777777~~ ^AShiroia on the tops of hills, the land is ploughed, cross ploughed and levelled, the ashes are thrown, and the machini seeds are broadcasted, and mixed with the soil by ploughing. The last operation is the working of ~~the~~^{soil} while it is raining. While the ~~soil~~^{soil} is worked, a man stands ^{on it} and presses hard so that the seedlings get a uniform stand// On/corruption. When the land is uneven with a lot of stumps of trees and bushes standing on it, all the operations are done by hand. The principal tool used is pick.

In Fernes^A, Satary, ^ASanquellir, ^ASarcusa, ^AGandona etc. where machini forms an important crop, on account of the hilly nature of the country, broadcast sowing is finished by the end of June or ~~7777~~^{1st} week in July, but in other places, the sowing time extends to the end of July.

One hand-sowing is given about the middle of August, when the crop stands about a foot high. Thinning out thick places and filling up of blanks is also done about the same time.

In the Goa territory, a good deal of arland cultivation of machini is found scattered in small blocks in the forests. The method of cultivation adopted is called Suaria, it consists in burning the soil before the sowing of seed. This kind of cultivation is extensively met with in the forest of Satary, ^ASanquellir, ^ASarcusa and ^AFernes. The Suaria growers are Savalia (or unkie), Avadac, Maratnac and hill tribes.

In Sumeria tillage, all work is required to be done by the hand, because the lands are not accessible to bullocks. In this system, the coppings of trees and bushes are cut down in the month of April and spread thickly all over the area. By the 15th of May these clearings are burnt in situ and the nachini seed is sown broadcast in the ashes. The seed begins to germinate after the setting in of the monsoon. One hand-weeding is given to the crop during July. The crop needs watching in the hills. The crop is harvested in the month of October or November. It is dried and left in small heaps. The threshing is done from December to February.

In some places where water facilities exist, an early variety of nachini called Sivas is cultivated sparingly under irrigation.

Harvesting and Threshing.

Harvesting is done from September to December according to the situation and methods of cultivation adopted.

When the ears are large, they are usually cut by hand and the straw is allowed to stand in the field. In Sumeria the straw is generally left standing. It is burnt in situ for the next year's crop. In other cases when the crop is small, it is cut with a sickle, left in the field to dry for about 4 days and then it is bundled and brought to the threshing yard for threshing. The grains are separated from the stalks by beating with bamboo sticks or treading under the feet of cattle according to the quantity of crop to be threshed.

Output.

Under ordinary conditions one seer of seed produces 7 to 10 cuto (one cuto = 8 seers) of nachini, but in Sumeria it is said that one seer of seed yields 20 cuto and more of nachini.

The output from a carefully cultivated upland field ranges from 700 to 800 lbs. per acre; but the same land in a very favourable season and under similar cultivation yields 1200 to 1500 lbs of grain and 2000 to 2400 lbs of straw.

It is
as a food grain ~~is~~ most popular amongst the poorer
classes.

Machini straw is generally considered as an inferior
sort of fodder, but it is not so, as could be seen from the
figures of analysis given below.

Basine value of Machini and Rice Straw*

| Moisture | Oil | Proteins | Digesti- ble car- bohydra- tes. | Starch | Total |
|------------------|------|----------|--|--------|-------|
| rice straw | 2.50 | 1.05 | 2.25 | 40.40 | 46.10 |
| machini straw | 2.65 | 1.45 | 2.65 | 52.65 | 58.40 |

| | |
|---------------------|-------|
| * Contains nitrogen | 0.16 |
| | 0.58 |
| * Contains ash | 14.50 |
| | 2.50 |

Sugarcane.

Amongst the earthen crops sugarcane heads the list. It
requires intensive cultivation, more capital, more labour,
more water and more labour. Really it is crop of a rich
man. If the crop is carefully and intensively cultivated
it pays well.

Sugarcane is a crop of 12 months and therefore it is
grown wherever there are facilities for irrigation through-
out the fair season.

In Guj, in order to save the expenses on watching the
crop from jackals, vics, cattle and men, several cultiva-
tors join together and grow sugarcane in one block as far
as possible. The cane fields are protected by barbed or

* Bulletin No. 55 of 1915 Department of Agriculture,
Bombay, pp. 40-41.

or other stick fences or by erecting temporary mud walls which are about 4 feet high and 4" to 6" thick. These walls are protected from rain by cones of coconut fronds.

In the Astragar tract (consisting of Colamb, Kurin, Neterin and Jacky name) where there is a plentiful supply of stream water, sugarcane is cultivated on a fairly large scale individually as well as on the cooperative basis. Sugarcane is grown in small lots all over the tea territory but greater cultivation is found in Canacona, Sangam, Ponia and Furner talukas. The area cultivated is generally calculated on the number of sets planted. In forest tracts 4 or 5 ratoons are ^{said to be} taken but in other places only one or at the most two.

Soil.

Sugarcane requires well drained soil. In low-lying areas the growth is comparatively smaller than on high lands. In tea sugarcane is cultivated on holler or axol lands having irrigation facilities. If the plantation is situated on the bank of a stream, which is the case in several places, the cane crop gets submerged under water, sometimes for several days together during the rains. This causes some check in the growth of the crop.

Preparation of Land.

The field which has grown a kharif crop of rice is generally selected. The common method followed all over the territory is to plant ^{cane} in trenches which are usually dug by hand. Working the sugarcane land with the plough is only occasionally met with. The first step in the preparation of land by the latter method is to make a few temporary channels in the field and thus lay water on the whole area. To facilitate the wetting of the field a spoon shaped water-thruster (Surli) is used to distribute the water from the channel. Two or three days after, the land gets soaked, the field is ploughed and cross ploughed 3 to 5 times. Clods are then broken and the plot is levelled and divided into sections.

The divisions of land into sections are then horizontally furrowed with ludli leaving a distance of about 3 feet between 2 furrows, which are termed marra. The

furrows are about a foot deep and about 2 inches wide. The earth removed from the furrows is piled up carefully along the side of the furrow. When the furrows are ready, dried branches of trees, cowhorns, dried sugarcane leaves etc. are thrown in the trenches and burnt. This is the usual practice, but in some cases only ashes are spread in the trench, water is let in, the soil is stirred well with hoes and turned into mud.

Planting.— The top sets of sugarcane about 1½ feet long which have already partially sprouted are then carefully laid in the trench just touching one another or sometimes overlapping each other. Planting time extends from January to April. About 13000 to 15000 sets are planted per acre.

Irrigation.

The second water is applied on the second day after planting and third on the fourth day and afterwards the crop is regularly irrigated on alternate days or every third day according to the nature of the soil. Thus about 25 to 30 waterings are given before setting in of the non-sock. Generally in sea sugarcane is not irrigated after the rains, the result is that the tops of canes begin to wither for want of moisture.

Top dressing.

Some give two to four weedings to the crop, but generally only two are given. When this is over, small quantities of ashes are applied to each stump and the crop irrigated. In plain areas cowhorns, ashes and fish are applied to the cane crop in one or two doses and each time a small quantity of earth is gradually drawn from the ridges and put near the canes. Earthing up is fully completed by the end of May. In hilly tracts where any amount of green loam is available, there is in the month of June, both the sides of canes in the trench are filled with green loam very thickly, which are then covered over with earth dug from the side of the ridges, leaving only a very thin ridge between two lines of cane.

From the third month to the end of the year, the dried leaves of the canes are stripped off from time to time and thrown in the plantation. As these leaves decay, they form part of the manure. The stripping gives better aeration to the standing crop and intensifies the colour of the cane with uniform ripening. In some places the cane leaves are wrapped round the canes to prevent molestation from jackals and rats. This goes on till the middle of September, when the canes are given supports (as in Sanáona) which are either of bamboo or of some juncly sticks. This prevents the cane from lodging. No further attention is given to the crop till the time of harvesting except watching.

Manufacture of Jaggery.

When the crop is 11 to 12 months old, the cutting of canes and jaggery making commences. Wooden mills are in general use, although improved iron three roller Poona mills are found here and there in the territory. The wooden mills are worked by men, five men working at each arm of the mill.

The pans for boiling juice are made of iron or rarely of copper. They are small and deep like the confectioner's pans. The boiling takes 2 to 2½ hours for one boiling. Surpassing the boiling pan hold about 60 pots of juice, the boiling commences when about 5 pots are put into the pan and the rest of the quantity is added from time to time until the pan is filled to its full capacity. Very small quantity of scum is generally removed. The cul milk is semi-liquid and is of ^alight colour. The jaggery is cooked in small shallow wooden Cattota. Further solidifying is done in pits which are lined with pieces of guni or some other rough cloth. In Sanáona jaggery from Cattota is transferred to earthen pots in which it is preserved.

In some places like Collex, Curti, Gajel in Pondia improved mills and improved shallow pans are found in use. In these places fairly good quantity of cul is made, which is preserved in herosine tins.

Varieties.

One variety is seldom found in one field, there is always a mixture of two or three varieties. The principal kinds found are red hard cane and striped cane (Sankatou). Both are medium in thickness. The third thin cane variety is not with in Sanáona.

Regulation No. 2.

Conditions (inserted in 1910) under which premium
bulls are ⁵granted to villages by the Bombay Agri-
cultural Department.

1. Half the initial cost of a premium bull to be paid by the agent himself or on behalf of subscribers resident in the village concerned.
2. A. 4 per cent to be paid by Government to the agent for maintenance charges.
3. The bull to be the property of the agent after three years if he had subscribed half the initial cost himself. If the cost has been raised by subscription the bull to be sold after three years and the proceeds utilized in paying towards the cost of another premium bull.
4. The bull to be the property owned for by the agent and to be allowed to graze with his cattle. The agent to be held responsible for the bull's condition.
5. The services of the bull to be made available free of charge to cows belonging to residents of the village only. The bull not to be allowed to cover more than one cow a day. In case of more than one cow being brought on one day the best cow to be selected for the services of the bull.
6. A register of cows covered to be kept by the village officer from the information supplied to him by the agent.
7. Premium bulls are not to be worked.
8. Breach of above rules involves forfeiture of the bull with no compensation.

Appendix, p. 2

Instructions for Making Concentrated Lime Sulphur

| | |
|--------------------|-------------|
| Lime | 50 lbs. |
| Sulphur or Sulphur | 100 lbs. |
| Water | 50 gallons. |

In making the wash, ~~use~~ ^{use} slake the lime in about 10 gallons of hot water adding the lump of lime gradually to avoid too violent boiling and spilling over. The sulphur must be thoroughly powdered and mixed into an even stiff paste without lumps (before adding to the lime). Pour in the sulphur paste gradually during the slaking, stirring constantly to prevent the formation of lumps, and when the slaking has finished add the full amount of water and boil gently for one hour. Slightly larger quantities of water may be added to compensate for evaporation while the kettle is on fire, or the volume might be kept ~~up~~ constant by adding successive small quantities of water to hold the mixture at the original level, as shown by a notch on a stick resting on the bottom of ~~the~~ kettle, and marked when the mixture first begins to boil.

This concentrate may be kept for a long time if it is kept in a barrel with a thin layer of kerosene oil kept floating on the top to prevent access of air.

The mixture should be boiled till it gets a bright orange red colour, in galvanized iron tubs and never in copper vessels. At the time of spraying this concentrate should be diluted to thirty times its volume with water.

The sprayers should always be thoroughly washed after spraying, otherwise they are corroded. Always strain the mixture over a sieve usually provided with sprayers. If not properly strained the mixture will clog the nozzles.

Glossary of vernacular words of crops, kinds of wood
used in manufacture of implements & with their scientific
names.

| Seri- al No: | English name | Botanical name | Concani name |
|-----------------|--|--|--------------|
| | <u>Cultivos</u> <u>Crops.</u> | | |
| | <u>Cereales, Cereais</u> | | |
| 1 | Rice <i>Arroz.</i> | <i>Oryza sativa</i> | Shate |
| 2 | Great millet <i>Milho</i> <i>Sorgo</i> | <i>Andropogon sorghum</i> | Janlo' |
| 3 | Full rush millet <i>Bajri</i> | <i>Pennisetum typhoides</i> | Bajri |
| 4 | Inferior millet <i>Nachininu</i> | <i>Echinochloa crusgalli</i> | Nachininu |
| 5 | do <i>Pacol.</i> | <i>Paspalum serotinum</i> | Facod |
| 6 | do <i>Sauvon</i> | <i>Panicum miliare</i> | Savo |
| 7 | Italian millet <i>Cangas</i> | <i>Setaria italica</i> | Cangas |
| | <u>Legumes</u> <u>Folhas.</u> | | |
| 8 | Pigeon pea <i>Ervilha de Angola.</i> | <i>Cajanus indicus</i> | Tor |
| 9 | Green gram <i>Colita.</i> | <i>Bolichos biflorus</i> | Gulith |
| 10 | Black gram <i>Mrida</i> | <i>Phaseolus mungo</i> var. <i>radiatus</i> | Cori' |
| 11 | Green gram <i>Veijo Mungo</i> | <i>Phaseolus Mungo</i> | Moone |
| 12 | Cowpea <i>Veijo frade</i> | <i>Vigna catiana</i> | Choulli |
| 13 | Indian bean <i>Veijo frade preto.</i> | <i>Bolichos Lablab</i> | Sal |
| 14 | Velvet beans <u>Sementes oligginosas</u> <u>Oil seeds.</u> | | |
| 15 | Sesamum <i>Sergelim</i> | <i>Sesamum indicum</i> | Till |
| 16 | Niger seed <i>Verdeira de India nica</i> | <i>Crotalaria abysso-</i> | Kale Till |
| 17 | Crownnut <i>Amendoim</i> | <i>Arachis hypogea</i> | Phicna |
| 18 | Casters <i>Picino</i> | <i>Picinus communis</i> | Grand |
| 19 | Safflower <i>Cartamo.</i> | <i>Carthamus tinctorius</i> | Jushi |
| 20 | Confit tree <i>undera</i> | <i>Calophyllum in-</i> <i>phyllum</i> | Pica |
| 21 | <i>Fosteira</i> | <i>Tylococcus</i> <i>wightiana (Flue)</i> | Postar |
| 22 | Karanji tree - <i>Favas de chapa</i> | <i>Pongamia elabra</i> | Karanj |

Serial No. Malish. name : Botanical name : Konkani name

Fibras
Fibres.

- 32 : Cotton *Algodão* : Gossyrium : Cáras
 34 : Sani hant ^{carhans} *linho da Índia* : Protolaria juncea : Són
 35 : Sisal ^{linho} *Sisal* : Agave sisalana : Raisei e Fibreoulos
 : Ioots ani Tubers
 36 : Taro : Colocasia : Páti
 37 : Sweet potatoes : Ipomea Batatas : Caneus
Batata doce
 38 : A variety of YAM : Dioscorea : Zai-caneá
Inhamé de cá
 39 : Inhamé ^{da redonda} : Dioscorea : Curandá
 40 : Inhamé ^{da china} : Dioscorea var. : Són or Chiná
 41 : Tapioca *Mandioca* : Manihot utilisima : Farinc-mulan
 42 : Onions *cebolas* : Allium cepa : Canio
Horradicas.
Herbar crops ani Vegetables

- 33 : Chillies *Pimentas* : Capsicum species : Kisanáo
 34 : Prin jals *Brinjela* : Solanum melongena : Vaingués
 35 : Lady's finger *Quiabo* : Hibiscus esculentus : Fendio
 36 : Cowpea *Frijão feeding* : Vigna catiana : Váli
 37 : Cluster beans : Cyamopsis : Chitli-mitki
Tikki-mitki : psoralidifis : (Gowari)
 38 : Radish *Rábano* : Raphanus sativus : Kélo
 39 : Snake gouri *Patolo* : Tricosanthus : Fajolón
anguina :
 40 : Niles gouri *Amorimia* : Luffa acutangula : Chonales *fonsida*
 41 : Bropes gouri *Musta cota* : Luffa aegyptiaca : Sander chonales
 42 : Bottle gouri *Atona cabaci* : Laganaria vulgaris : Konkani Judi
 43 : Pumpkin *porquira* : Cucurbita maxima : Buihi
 44 : Small gouri *Fendali* : Cerehalantia indica : Fendolim
 45 : Cucumber *Pilino* : Cucumis sativus : Fipri
 46 : Water melon *Melancia* : Citrullus vulgaris : Calline
 47 : Sugar-cane *Caná de açúcar* : Saccharum : Kabbu
officinarium

Frutas
Fruits.

- 48 : Coconut *Abaco* : Cocus nucifera : Hal
 49 : Patalnut *Abaca* : Arca catechu : Surari
 50 : Mango *Manga* : Mangifera indica : Aito

| Series | English name | Botanical name | Common name |
|--|---|---|-----------------------|
| 51 | Jack <i>faca</i> | <i>Astocarpus</i> <i>interfolius</i> | Fónos |
| 52 | Small fruit tree <i>fruto do tao</i> | <i>Astocarpus</i> <i>incisa</i> | Neer phónos |
| 53 | Indian mango tree <i>prindas</i> | <i>Carcinia</i> <i>indica</i> | Bhirani |
| 54 | Lime <i>Limão</i> | <i>Citrus</i> <i>acida</i> | Limbo |
| 55 | Lemon <i>Cidra</i> | <i>Citrus</i> <i>medica</i> | Mahalinga |
| 56 | Forale <i>Taranja</i> | <i>Citrus</i> <i>isohena</i> | Taranja |
| 57 | Mozambique orange <i>Laranja</i> | <i>Citrus</i> <i>aurantium</i> | Laranja |
| 58 | Plantain <i>Banana</i> | <i>Musa</i> <i>sarientum</i> | Quellen |
| 59 | Pine apple <i>Ananaz</i> | <i>Ananas</i> <i>sativa</i> | Anas |
| 60 | Bullock's heart <i>Anoniceira</i> | <i>Anona</i> <i>reticulata</i> | Anona |
| 61 | Mustard apple <i>ala</i> | <i>Anona</i> <i>squarosa</i> | Anter |
| 62 | Cashewnut <i>caju</i> | <i>Anacardium</i> <i>occidentale</i> | Caju |
| <u>Plantas Forragieras</u> <u>Forage Crops.</u> | | | |
| 63 | Lucerne grass <i>Luzerna</i> | <i>Medicago</i> <i>sativa</i> | Vilayti chas |
| 64 | Guinea grass <i>Capim de Angola</i> | <i>Panicum</i> <i>tomentosum</i> | Chini chas |
| 65 | Shevri <u>Arbustos Forragieras</u> <u>Forage Shrubs.</u> | <i>Sesbania</i> <i>peruviana</i> | Shevri |
| 66 | <i>Rumbolo</i> | <i>Picus</i> <i>cleverata</i> | Corlar |
| 67 | Indian Tulip tree <i>Pau rosa</i> | <i>Thespesia</i> <i>populnea</i> | Pranti |
| 68 | Indian coral tree <i>bolhas da tinda</i> | <i>Erythrina</i> <i>indica</i> | Fonseco Pomqueró |
| 69 | <i>Bentika</i> | <i>Briellia</i> <i>retusa</i> | Ascan |
| 70 | <i>Pau de canoa</i> | <i>Helicteres</i> <i>isora</i> | Keven |
| 71 | — | <i>Grewia</i> <i>tiliaefolia</i> | Iharan |
| 72 | <i>Cardo</i> <u>Arbustos verdes</u> <u>Green Laurels.</u> | <i>Acanthus</i> <i>liliefolius</i> | Maranti <i>Madrão</i> |
| 73 | Sann herb <i>linho da india</i> | <i>Oretalaria</i> <i>juncea</i> | Sann |
| 74 | — | <i>Aithya</i> <i>vasica</i> | Ailso |
| 75 | — | <i>Calotropis</i> <i>picantia</i> | Fui |
| 76 | <u>Arbustos florestais</u> <u>Forest Trees.</u> <i>Madeira.</i> | <i>Sesbania</i> <i>aculata</i> | Ihaincha |
| 77 | <i>Antela</i> | <i>Lacustris</i> <i>parviflora</i> | Panf |
| 78 | <i>Formosa da India</i> | <i>Acacia</i> <i>arabica</i> | Nabal |
| 79 | Teak <i>Teca</i> | <i>Tectona</i> <i>grandis</i> | Sael |
| 80 | Wax-tail palm | <i>Caryota</i> <i>urens</i> | Eberlé pal |
| 81 | Bamboo <i>Bambu</i> | <i>Dendrocalamus</i> <i>strictus</i> | Contio |

| Nome das comunidades | | | Nome das comunidades | | |
|----------------------|------------------|-------|----------------------|-------------|------|
| 1910 | 1916 | 1922 | 1910 | 1916 | 1922 |
| Rps | Rps | Rps | Rps | Rps | Rps |
| <u>Olhuso</u> | | | <u>Sanguelice</u> | | |
| Ambarim | 70 | 83 | 81 | Arona | 6322 |
| Bygossim | 8037 | 10807 | 7376 | Abvolpala | 2705 |
| Bambolim | 2603 | 4352 | 4432 | Arvalim | 43 |
| Batim | 12346 | 15417 | 27746 | Bicholim | 291 |
| Calafene | 14161 | 26165 | 32239 | Bordem | 1115 |
| Caraim | 1367 | 1457 | 2367 | Gudmane | 790 |
| Carambolim | 51533 | 91076 | 51107 | Dumacim | 20 |
| Chimbel | 657 | 640 | 494 | Latabarcim | 373 |
| Chorão | 29830 | 30696 | 41735 | Kenacem | 68 |
| Cortim | 5894 | 7109 | 3746 | Mulgão | 2040 |
| Cujira | 2413 | 2944 | 2856 | Navelim | 3944 |
| Curea | 1897 | 3179 | 3067 | Piligão | 1696 |
| Durgavaddy | — | — | — | Pissurlem | 140 |
| Ellu | 2420 | 5119 | 2748 | Pala | 498 |
| Gancim | 6356 | 7477 | 7602 | Surla | 285 |
| Gandaulim | 10870 | | | Sirigão | 3668 |
| Goavelha | 13870 | 15241 | 20559 | Sarvona | 848 |
| Goltim | 9882 | 11527 | 16043 | Uzão | 78 |
| Guia | 13720 | 19224 | 26269 | Vaengueppim | 1105 |
| Hallar | 12127 | 14230 | 18382 | | |
| Mandur | 1405 | 1219 | 1582 | | |
| Mercurim | 1206 | 1755 | 2389 | | |
| Korombim o grande | 12687 | 13414 | 15220 | | |
| Korombim o pequeno | 7725 | 11469 | 18144 | | |
| Murda | 5456 | 8336 | 12547 | | |
| Naroe | 1689 | 1915 | 2407 | | |
| Navelim | 13635 | 14292 | 15589 | | |
| Nauri o grande | 51223 | 33979 | 54440 | | |
| Nauri o pequeno | 801 | 943 | 1438 | | |
| Norowaddy | 1596 | 2185 | 2634 | | |
| Talaulim | 3718 | 3547 | 7956 | | |
| Taligão | 6803 | 11273 | 11676 | | |

+ Less amount of salt is due to the admission of salt water on the land during the ^{1st} year of the triennial period.

Statement showing variations in extent of the Rice lands of the Community.

| Some das comunidades | | | Some das comunidades | | | | |
|----------------------|------------------|-------|----------------------|------------|------|------|-------|
| 1910 | 1916 | 1922 | 1910 | 1916 | 1922 | | |
| Rps | Rps | Rps | Rps | Rps | Rps | | |
| Olhos. | | | Sungulim | | | | |
| Inbarim | 70 | 83 | 81 | Arona | 6322 | 7485 | 11662 |
| Iyossim | 8037 | 10807 | 7376 | Adulpale | 2705 | 1430 | 2737 |
| Mambolim | 2603 | 4352 | 4432 | Arvalim | 43 | 104 | 88 |
| Batim | 12346 | 15417 | 27746 | Bicholim | 291 | 450 | 378 |
| Alafur | 14161 | 26165 | 32239 | Bordem | 1115 | 1174 | 1351 |
| Arain | 1367 | 1457 | 2367 | Budnem | 790 | 1200 | 1225 |
| Mrambolim | 51533 | 91076 | 51107 | Dumacim | 20 | 30 | 22 |
| Limbel | 657 | 640 | 494 | Latabarim | 373 | 280 | 46 |
| Choras | 29830 | 30696 | 41735 | Kanarem | 68 | 117 | 69 |
| Corlim | 5894 | 7109 | 3746 | Mulgao | 2040 | 2770 | 3624 |
| Ujira | 2413 | 2944 | 2856 | Kavelim | 3944 | 6342 | 6436 |
| Burea | 1897 | 3179 | 3067 | Piligao | 1696 | 2023 | 2811 |
| Murgavaddy | — | — | — | Pisourlem | 140 | 140 | 165 |
| Ellu | 2420 | 5119 | 2748 | Pale | 498 | 557 | 724 |
| Gancim | 6356 | 7477 | 7602 | Surla | 285 | 386 | 675 |
| Pandaulim | 18870 | | | Sirigao | 3668 | 4821 | 5179 |
| Parvelha | 13870 | 15241 | 20559 | Sarvona | 848 | 943 | 999 |
| Goltim | 9882 | 11527 | 16043 | Usgao | 78 | 49 | 19 |
| Qua | 13720 | 19224 | 26269 | Vaenguffim | 1105 | 1473 | 2161 |
| Mallar | 12127 | 14230 | 18382 | | | | |
| Handur | 1405 | 1219 | 1582 | | | | |
| Mercurim | 1206 | 1755 | 2389 | | | | |
| Corombim o grande | 12687 | 13414 | 15220 | | | | |
| Corombim o pequeno | 7725 | 11469 | 18144 | | | | |
| Murda | 5456 | 8336 | 12547 | | | | |
| Karoe | 1689 | 1915 | 2407 | | | | |
| Kavelim | 13635 | 14292 | 15589 | | | | |
| Curio grande | 51223 | 33979 | 54440 | | | | |
| Curio pequeno | 801 | 943 | 1438 | | | | |
| Mowaddy | 1596 | 2185 | 2634 | | | | |
| Alaulim | 3718 | 3547 | 7956 | | | | |
| Alaigao | 6803 | 11273 | 11676 | | | | |

+ Less amount of cult. is due to the admission of salt water on the land during the 1st year of triennial period.

| <u>Ponda</u> | 1910 | 1916 | 1922 |
|--------------|-------|-------|-------|
| Adeolna | 1043 | 1587 | 2263 |
| Borim | 1200 | 1538 | 1815 |
| Bandora | 4191 | 4728 | 6592 |
| Betora | 214 | 210 | 197 |
| Boma | 2446 | 3160 | 4665 |
| Betquin | 677 | 1074 | 1454 |
| Cundaim | 15243 | 15945 | 26055 |
| Coddar | 211 | 372 | 229 |
| Gondola | 1578 | 1862 | 2518 |
| *Mariaim | 26999 | <hr/> | |
| Orgão | 1478 | 2218 | 2049 |
| *Priol | 28 | <hr/> | |
| Sirodá | 11293 | 11195 | 17131 |
| *Talaúlim | 2238 | <hr/> | |
| Tuirém | 1972 | 2614 | 2980 |
| *Velinã | 1890 | <hr/> | |
| *Verem | 1071 | <hr/> | |
| Volvai | 289 | 337 | 548 |
| *Zagurtem | 415 | <hr/> | |

*. Figures of rent are not separately available.

Statement showing the variations in rent of the Rice lands of the Community from 1910 to 1922

do anjoan, p... e... a...
ano 1910 - 1922.

| | | Arroyal | 1910 | 1916 | 1922 |
|----|--------------------|----------|-------|-------|-------|
| 1 | Scha Anbarim | 0.6990 | 72 | 83 | 81 |
| 2 | Azyossim | 73.1581 | 8037 | 10807 | 7376 |
| 3 | Bambolim | 15.2174 | 2603 | 4352 | 4432 |
| 4 | Banguenim | — | — | — | — |
| 5 | Batim | 126.1859 | 12346 | 15417 | 27746 |
| 6 | Calapor | 253.0986 | 94161 | 26165 | 32239 |
| 7 | capão | — | — | — | — |
| 8 | Carairó | 18.4076 | 1367 | 1457 | 2367 |
| 9 | Carumbolim | 771.9808 | 51533 | 91076 | 51107 |
| 10 | chimbél | 7.4341 | 657 | 640 | 494 |
| 11 | Chorão | 352.4825 | 29830 | 20696 | 41735 |
| 12 | Corlim | 122.0419 | 5894 | 7109 | 3746 |
| 13 | Cujira | 23.5092 | 2413 | 2944 | 2856 |
| 14 | Combarjua | — | — | — | — |
| 15 | Curea | 18.1495 | 1897 | 2179 | 3067 |
| 16 | Durgavatt | 11.2713 | 2420 | — | — |
| 17 | Ellei | 56.2641 | 2420 | 5119 | 2748 |
| 18 | Gancim | 12.0844 | — | 7477 | 7602 |
| 19 | Gandaulim | 6.8618 | — | — | — |
| 20 | Goatim Moulá | — | — | — | — |
| 21 | Goa velha | 109.1744 | 13870 | 15241 | 20559 |
| 22 | Goltim | 166.1037 | — | 11527 | 16043 |
| 23 | Gua | 216.7184 | — | 19224 | 26269 |
| 24 | Mallar | 183.9683 | — | 14230 | 18382 |
| 25 | Manduch | 9.8713 | — | 1219 | 1582 |
| 26 | Mesurim | 29.6698 | — | 1755 | 2389 |
| 27 | Morombim o grande | 160.7988 | — | 13414 | 15220 |
| 28 | Morombim o pequeno | 182.2489 | — | 11469 | 18144 |
| 29 | Murdá | 49.3326 | — | 8336 | 12547 |
| 30 | Naróa | 20.1347 | — | 1915 | 2407 |
| 31 | Navelim | 264.0140 | — | 14292 | 15589 |
| 32 | Nurá o grande | 359.8221 | — | 33979 | 54440 |
| 33 | Nura o pequeno | 21.5782 | — | 943 | 1438 |
| 34 | Pauslim | — | — | — | — |
| 35 | Pangim | — | — | — | — |
| 36 | Renovatt | 17.7625 | — | 2185 | 2634 |
| 37 | Sicção | — | — | — | — |
| 38 | Talaulim | 70.4123 | — | 3547 | 7956 |
| 39 | Talalgão | 109.9879 | — | 11273 | 11676 |

Por ter no 1º ano
desta freguesia de
f. intermunicipal de
at. salgadas.

+

+

04

| Concelho | | Area | 1910 Kfz | 1916 Kfz | 1922 Kfz. |
|--------------|--------------|---|-------------|--------------------|---------------------|
| <u>Pondá</u> | | | | | |
| 1 | Borim 2 | ^{N.} 9.4142 | 1200 | 1538 | 1815 |
| 2 | Cundaim 7 | | 15243 | 15945 | 26055 |
| 3 | Bandorá 3 | 491082 ^{M²} | 4191 | 4750 ²⁸ | 6650 ⁵⁹² |
| 4 | Talaulim 12 | ^M 13.2913 | 2239 | | |
| 5 | Valinga 16 | 371018 | 1890 | | |
| 6 | Priol 12 | .. | 28 | | |
| 7 | Marcain | | 12 | | |
| 8 | Marcain 10 | | 26999 | | |
| 9 | Sirodã 13 | ^M 165 | 11293 | 11195 | 17131 |
| 10 | Ponchovady | | | | |
| 11 | Verim 17 | ^{Mais²} 566910 | 1071 | | |
| 12 | Betora 4 | | 214 | 210 | 197 |
| 13 | Goddar 3 | | 211 | 372 | 229 |
| 14 | Boma 5 | Bambus ^{moos} 1061 4 ³ / ₈ | 2446 | 3160 | 4665 |
| 15 | Tuicem 12 | X 299 8 | 1972 | 2614 | 2980 |
| 16 | Adaelua 1 | 1173 11 | 1042 | 1587 | 2363 |
| 17 | Gondola 7 | X 295 2 | 1678 | 1862 | 2518 |
| 18 | Orgão 11 | 4569 Bambus | 1478 | 2218 | 2049 |
| 19 | Betgiam 5 | 12326 Bambus | 677 | 1074 | 1454 |
| 20 | Volvai 1 | 4140 Bambus | 289 | 337 | 548 |
| 21 | Vagurbeni 17 | 532 ^{Mais²} | 415 | | |
| | | 3784 Bambus | | | |
| | | 523047 Bambus | | | |
| | | 3848 Bambus | | | |
| | | 457646 Bambus | | | |
| | | 77411 ^{M²} | | | |

| No. | Name of village | 1910 | 1916 | 1922 | Area in square meters |
|-----|----------------------------|--------|------|-------|-----------------------------|
| | | Rupias | Rps | Rps | |
| 1 | Pondok Among | 6323 | 7485 | 11662 | |
| 2 | Arwalim | 48 | 104 | 88 | |
| 3 | Nawclim | 3944 | 6342 | 6436 | |
| 4 | Advolpale | 2705 | 1430 | 2787 | |
| 5 | Paiholim | 291 | 450 | 378 | |
| 6 | Piligao | 1696 | 2023 | 2811 | |
| 7 | Bordene | 1115 | 1174 | 1851 | |
| 8 | Sulka | 285 | 386 | 675 | |
| 9 | Ludnem | 790 | 1200 | 1225 | |
| 10 | Manerem | 68 | 117 | 69 | |
| 11 | Dumacim | 20 | 30 | 22 | |
| 12 | Hogao | 78 | 49 | 19 | |
| 13 | Latambarim | 378 | 280 | 46 | |
| 14 | Mulgao | 2040 | 2770 | 3624 | |
| 15 | Sinigao | 3668 | 4821 | 5179 | |
| 16 | Pissurben | 140 | 140 | 165 | |
| 17 | Pale | 498 | 557 | 724 | |
| 18 | Sarwona | 848 | 943 | 999 | |
| 19 | Vaengonim | 1105 | 1473 | 2161 | |